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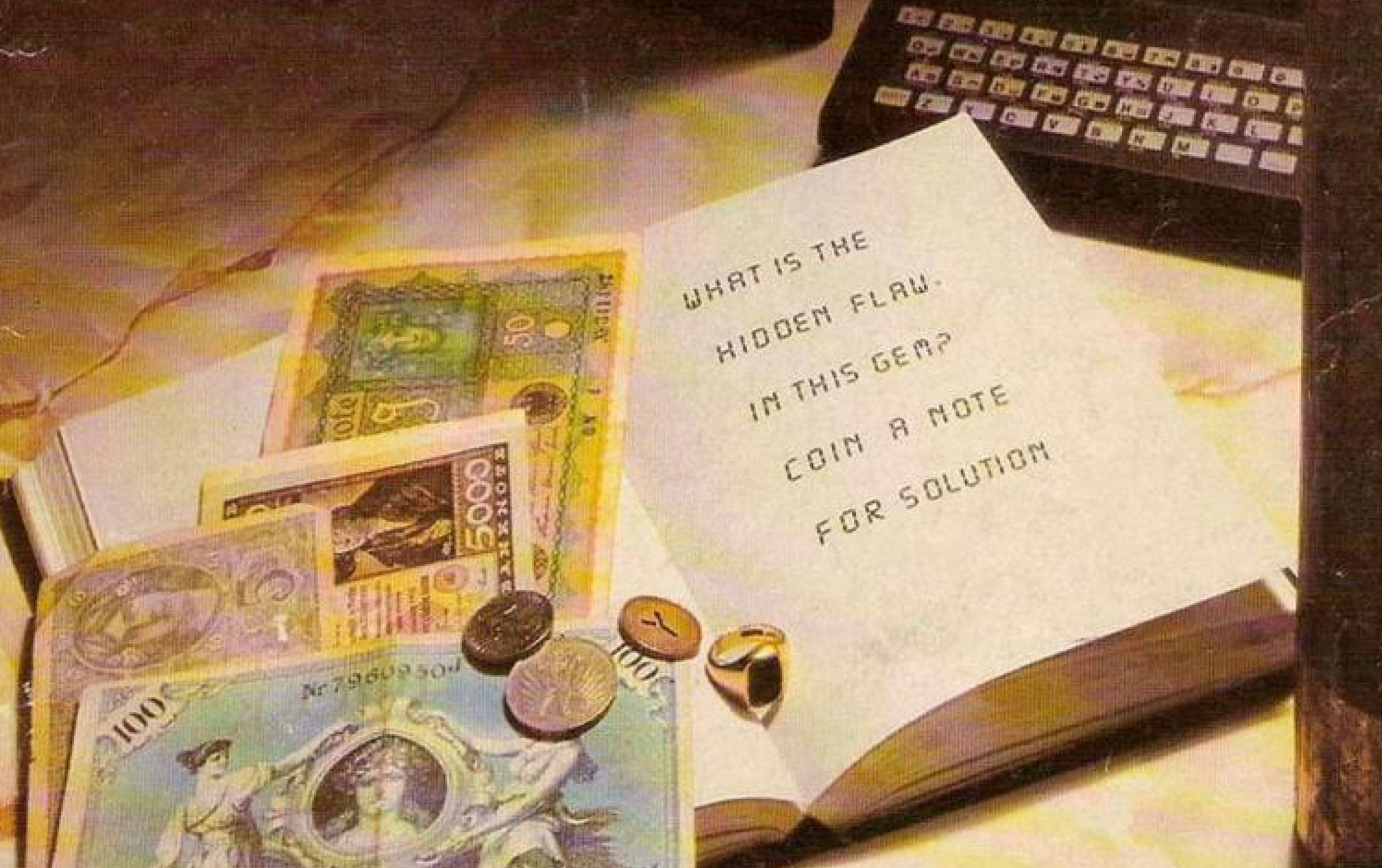
YOUR COMPUTER

APRIL 1982

Vol.2 No.4

Adventure on ZX-81

Vic-20 expansion
ZX-81 ports
BBC graphics
Hi-res on Vic-20
ZX-81 sorting



Win Memotech 64K RAM for ZX-81

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EDITORIAL

ON AVERAGE, a company has been formed every second day for the past year to supply and make software and hardware add-ons for the ZX-81. It is an impressive record and one from which some of the well-established computer companies could learn a great deal. It happened because the price of the ZX-81 was sufficiently low to create a new market of first-time buyers, most of them with very limited budgets.

Clive Sinclair knew that he was taking a big risk when he launched his ZX range of computers at the start of 1980: he had to strike a delicate balance between the power of his computers and setting a price low enough to attract the consumer markets. Luckily for all of us he struck the right formula. It is an obvious, if risky, recipe which, when it works, brings very high rewards, as can be seen from the rise in Sinclair's revenue from £4 million to £30 million in one year. Unfortunately, it is a formula which is only tried rarely by other companies.

Before the home-computer market really took off, most of the computers sold in Britain were American. The Americans regarded Britain as a wonderful market, mainly because they could sell computers over here at roughly twice the price they could sell them in the States. They did not sell them in vast quantities, but the profit margins compensated for that admirably. The dealers, and the manufacturers, always justified the high prices on the grounds that it was the only way they could afford to provide an acceptable back-up service. There was never, however, the slightest evidence that the service we were offered in the U.K. was any better than that offered in the States.

It is a mystery quite how Britain came to be regarded as a country where one could get away with over-pricing. The same arrangement pervades the motor-car industry in which an average car can cost up to £3,000 more than it would on the Continent. The British arm of Ford has said that but for the high prices it can charge in Britain it could not afford to keep its British manufacturing plants running at anything like the present level.

This is a peculiarly British problem for which, to a large extent, we are all to blame for allowing it to happen. The solution also lies in our hands: where we encounter products which are clearly over-priced, we must clearly state that we will not buy them until the price falls to a reasonable level. Take the market for Sinclair products as your guideline. We know that tapes of games packs can be sold quite profitably for between £5 and £10. We know that a 16K RAM pack can be sold for as little as £35. Some products will be better than others and might be more expensive but they should be in the same range.

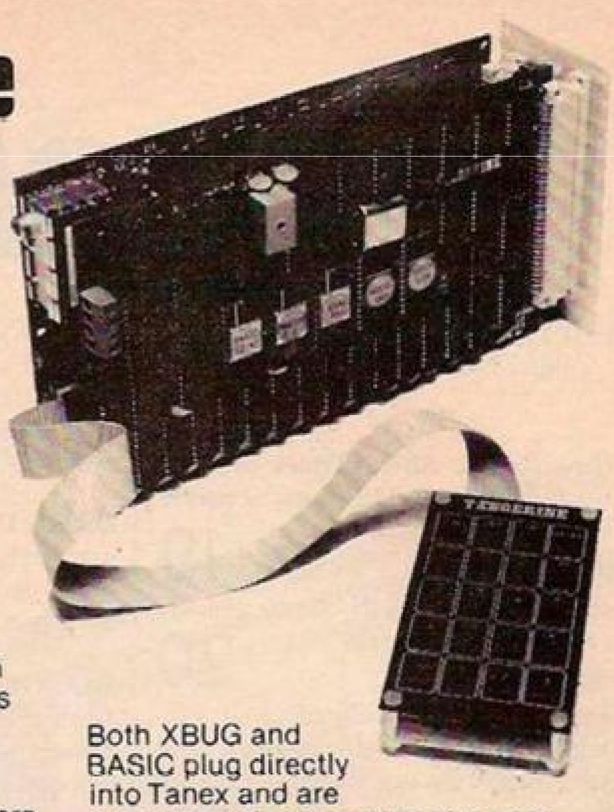
As new machines enter the market we will all have to be careful not to allow a surreptitious hike in prices. Take the Sinclair norm as your yardstick and barter. ■

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For the first time buyer or experienced user, Microtan 65 is a superb route into personal computing. If you are looking for a sophisticated machine with the capability of expansion into a professional system, then this is the computer for you. Step by step with the computer system designed for tomorrow. . . .



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Probably the most popular CPU (central processing unit) for personal computers, having a powerful instruction set and architecture.

2K Monitor TANBUG

The built-in 'mind' of the machine, TANBUG controls all system functions and gives comprehensive machine-code facilities. Functions include:- set and clear breakpoints, single step through program, execute program, copy block of memory, modify memory locations and much more.

Intelligent keyboard socket

For absolute beginners we can supply an easy to use 20-way Hex keypad; for the more experienced user there is a full typewriter style ASCII keyboard. Either way, Microtan will work out exactly which type you are using and act appropriately.

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Mini — motherboard

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* ★ XBUG
* ★ Cassette Interface

The first step in expanding your system. Tanex provides the extra facilities necessary for the serious programmer. Memory expansion: Tanex has provisions for up to 7K of static RAM and up to 14K of EPROM using 2716 or 2732 chips.

XBUG and BASIC

XBUG is a 2K extension to TANBUG that contains a mnemonic assembler and disassembler and cassette firmware running at 300 Baud CUTS, standard or high speed, 2400 Baud Tangerine standard with 6 character filenames. Tangerine have taken out a full O.E.M. licence for Microsoft BASIC, the microcomputer industry standard, this is a full feature implementation with interrupt and machine code handling, and a superb program editor.

Both XBUG and BASIC plug directly into Tanex and are supplied with comprehensive user manuals.

Parallel I/O

When fully expanded Tanex includes two V.I.A.s (Versatile Interface Adaptors) which implement the cassette interface and the parallel I/O ports. Software in TANBUG V2.3 enables you to plug in and use a Centronics type printer. The two V.I.A.s also contain counter timers that can be used for a variety of applications enhanced by the use of the integral handshake facilities.

Serial I/O

Also on the expanded board is a serial I/O port that can be used to interface RS232 or 20Ma loop terminals or VDU's, again all controlled by TANBUG V2.3.

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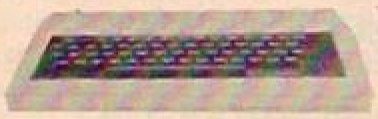
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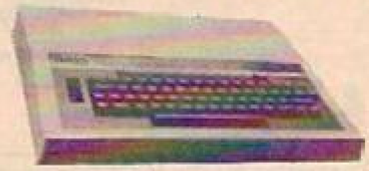
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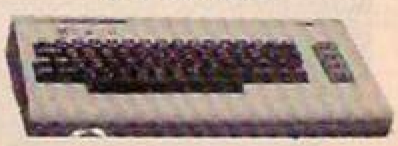
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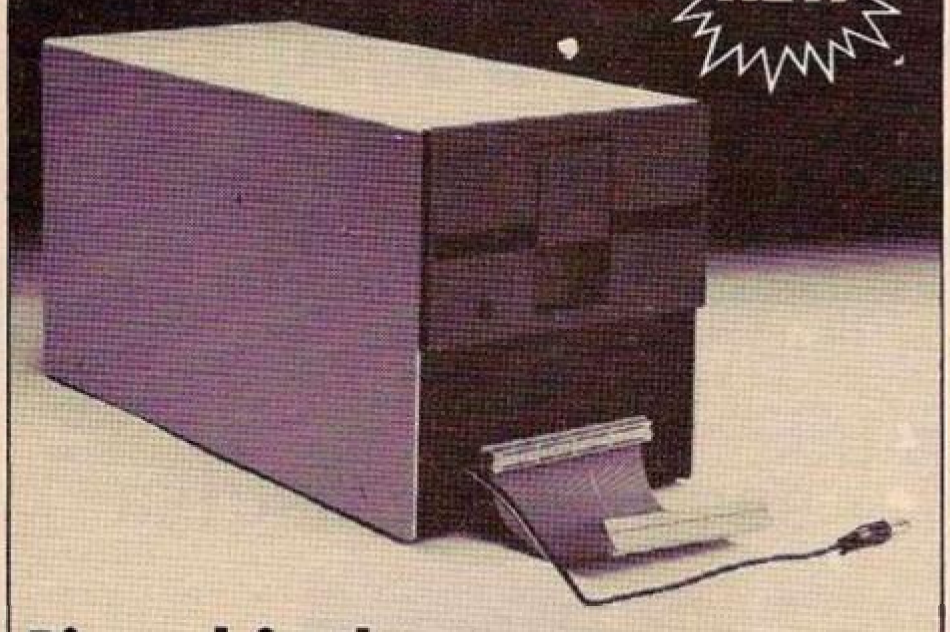
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The disk operating system (DOS) decodes the following commands used to control the storage of files on disk:–

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* EXEC read characters from disk as if from keyboard

The DOS also replaces the cassette operating system vectors as used by BASIC to allow the use of the following commands in Atom BASIC:–

LOAD load BASIC program from disk SAVE save BASIC program to disk FOUT open file for output
FIN open file for input SHUT close file EXT find extent of file PRT find value of pointer into file
PUT put number to file BPUT put byte to file SPUT put string to file GET get number from file
BGET get byte from file SGET get string from file

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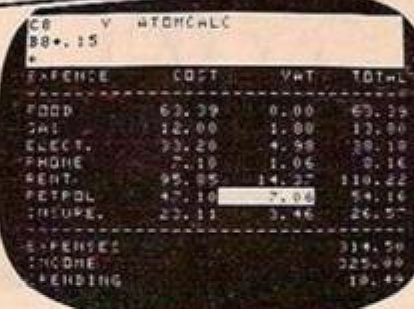
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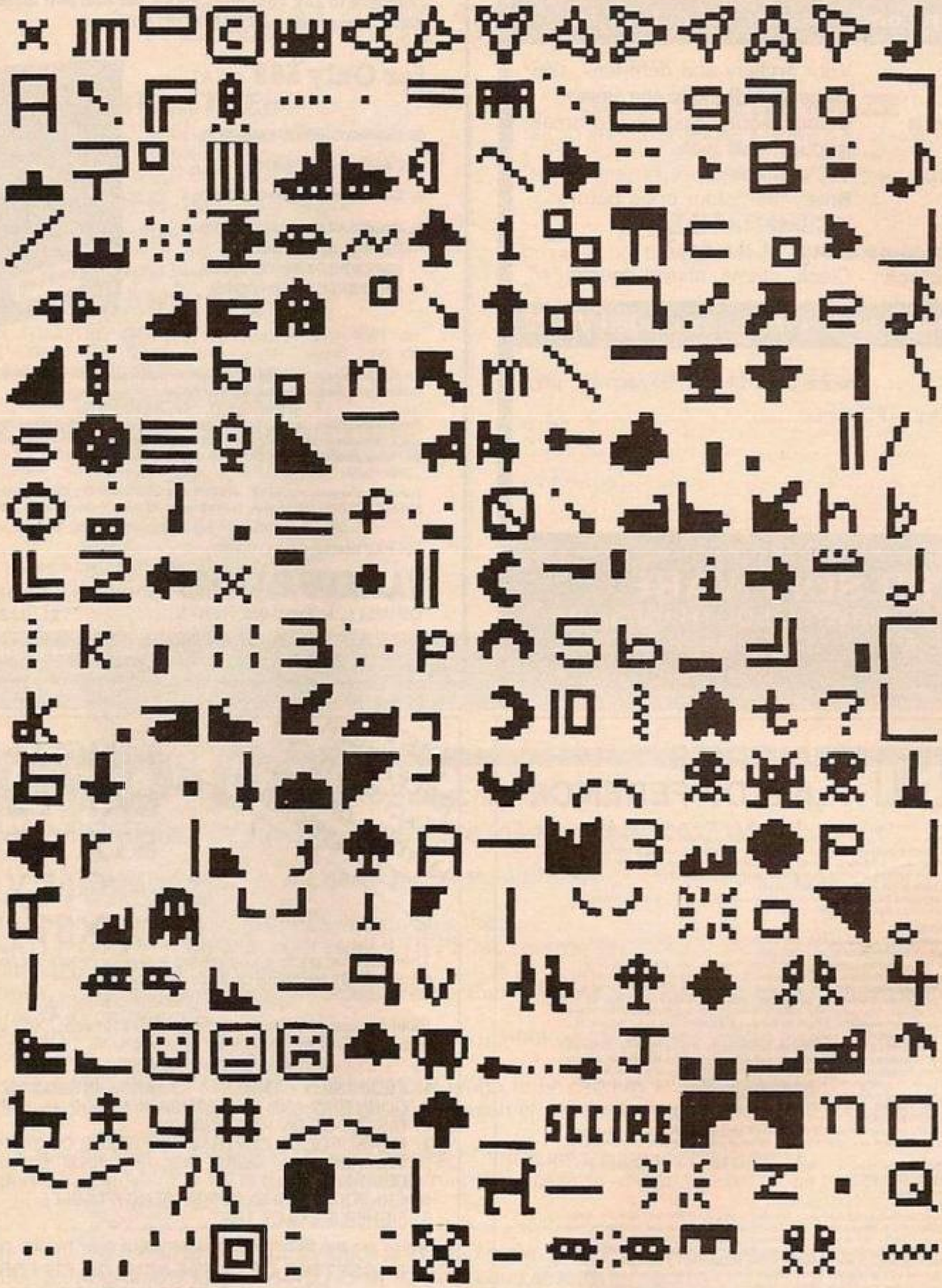
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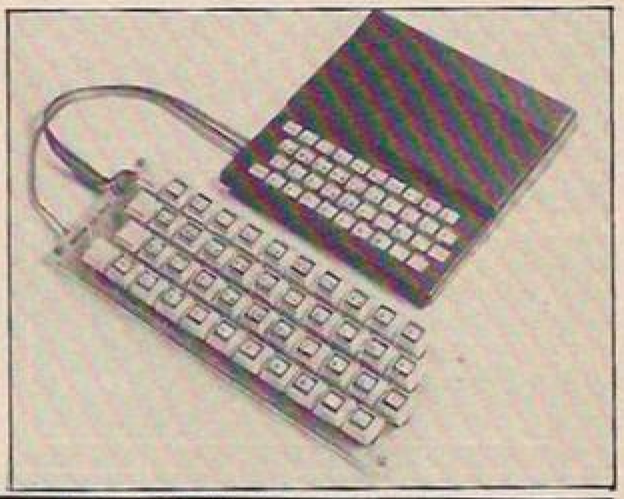
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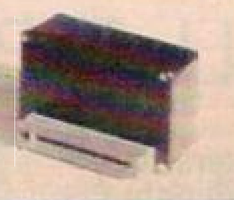
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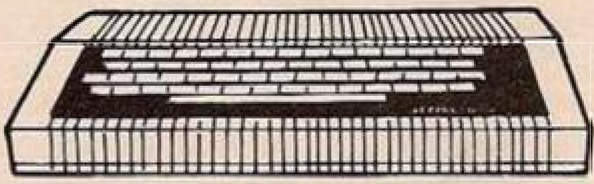
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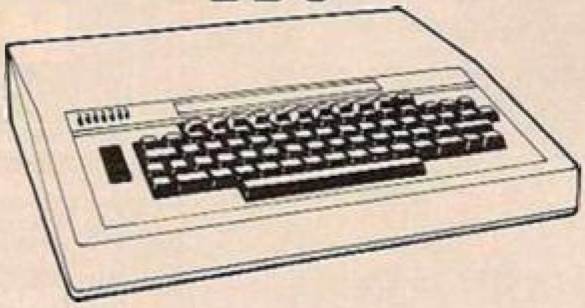
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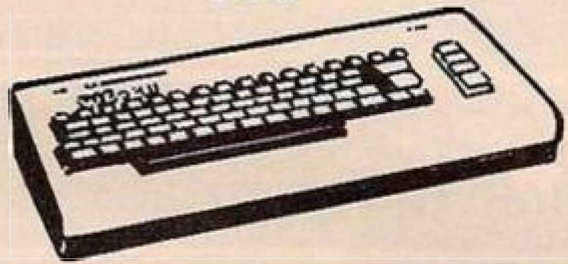
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WHITE ON WHITE

As soon as I had bought my Vic-20, I started to hunt for software for it. The first book I found was *Basic computer games* by D Ahl. To adapt them for the Vic, I had to give the screen sizes a good deal of thought — imagine what 24K Star Trek would be like with 22 columns — but I should not really have expected anything else.

This left me still needing to find a book written for the Vic. On the shelf of my local computer shop *Getting acquainted with your Vic-20*, by Tim Hartnell, published by Interface, seemed to fit my requirements perfectly. I gladly paid the £5.95 for this small paperback. How wrong I was — after entering just four programs, I realised the mistake I had made.

First, there was Labyrinth: despite correcting the mistakes according to the loose sheet supplied with the book, I still found other programming errors, not to mention the typing mistakes. When run, I obtained a set of jumbled letters that ran from one syntax error to the next. I then entered the version of life. A very important semicolon was missing, causing the program to run off the screen.

Still trying my best to come to terms with this book, I entered Space Raider. The stars and the spaceship were white — perfectly normal, except that the background was also white. Poke 36879,8 rectified this oversight.

By now, I had given up, but a friend of mine decided to enter draughts. There seemed to be terrible problems with his array. However many times I checked the listings I could find no fault on my friend's behalf. The problem seemed to be in lines 5110 and 5150 — the formula was outside the specified range — even though I had changed the mistake given on the extra sheet in line 5150.

In fairness, some of the advice offered by the book is reasonably good, although it occasionally has a flavour of the ZX-81 about it. For example, it mentions that you can use line numbers up to 9999. That may be true for the ZX-81, but for the Vic-20 10000 is perfectly acceptable.

Mike Potter,
Rudlow,
Wiltshire.

ROUGH RESPONSE

I read with real horror the statement made by Tim Hartnell in Response Frame in the February 1982 edition under the heading ZX-81 Problems: "Cleaning the contacts very gently with emery paper".

I would like to point out that you should never use emery paper on the printed-circuit board contacts as it can damage and wear away the covering of gold. I have been in computer engineering for some years and I have always cleaned the contacts with an ordinary ink or pencil rubber which must be grease free.

The way to use it is to rub the rubber over the contacts very lightly and if the rubber is clean of grease and oil, the deposit left will fast blow away.

Ian Wallace,
Enfield Lock,
Middlesex.

SINCLAIR'S SINS

My experience of the ZX-81 supports B Taylor's letter in the February issue of *Your Computer*. From July to November last year I received n.any assurances and five replacements for my first ZX-81. *All* these had the well-known fault,

```
SQR 0.25 = 1.3591409
```

together with others, for example:

```
SQR (0.5   * 128)
SQR (0.25  * 256)      = 436.7852
SQR (0.125 * 512)
1    — 1E-10           = 3
1000 — 1E-10           = 1024
```

Since the distributing organisation was not able to find me a ZX-81 without these faults, I was informed that the ROM would be replaced. When I received the machine on December 23, after this repair, there was a different set of faults, for example:

```
SQR 0.25 = 0.46901423
SQR (0.5   * 128) = 7.5042276
SQR (0.125 * 512) = 7.8525394
SQR 4    = 1.8760569
SQR 64   = 7.5042276
```

I returned this ZX-81 on December 31 with, as usual, full details of the faults. I have, to date, received no repair, replacement or explanation; I have been sent an acknowledgement.

I hope D Adamson — see letter in the same issue — is not being complacent and has checked his ZX-81 for arithmetic faults. I question whether the ZX-81 is suitable for use in schools while these faults and others persist.

H Hack,
Henley on Thames.

INFALLIBLE ZX-81

Ian Copestake in Your Letters, February 1982, opens with the statement "Computers do not make mistakes? My ZX-81 does —". He should not blame the computer for a program error.

The various points he raises are explained when you realise that the computer works in binary and not decimal, even when decimal is read in it has to be converted to the binary scale. Only numbers which are integral powers of 0.5, such as 0.25 and 0.0625 will give a finite number of digits. All other numbers under unity correspond to recurring series.

Thus, when such numbers are entered into the computer, they are rounded off to fit into the finite space allocated to storing the number. The program must be written to take this fact into account. The computer may not round off the way that will give the right answer when converted back.

Ian Copestake must have experienced this in line 20 because he wanted the interval to cover the range 0 to 1. If, however, the program had asked this, line 30 would have printed out up to 0.95 because the rounding off meant the numbers involved were slightly higher than needed.

However by increasing the range to a maximum of 1.01 as has been done in the program, the extra term of 1 is printed. If this had been done in lines 60 and 120 the first and third sets would have been completed. So that the evaluations match, you must ensure that the rounding off of the binary is done correctly. That can be done if a similar procedure modification is added to line 200 by writing

```
Y = INT (10*X+ 0.01).
```

With regard to the plot statement, which plots to the nearest integer, when a 0.5 is involved the nearest integer is equally likely to be up or down. So, the results obtained are quite consistent. If it is important to always round in one direction, the program must include an instruction which will do this.

C E Stephenson,
Wimborne,
Dorset.

RAM FEEDBACK

With reference to Stephen Adams recent review of ZX-81 memory extension packs: our 32K RAM pack does run with the standard ZX-81 power-supply unit sold with the machine. Sales of 2,000 of these expansion boards prove this. We are still selling 400 per month. Only 17 extra power-supply units, less than one per cent, demanded by customers.

As for the poor quality of the edge connector, we have changed our supplier. From April, we will be housing our RAM packs in an injection-moulded plastic case, to match the Sinclair ZX-81. The device will no longer suffer from 'wobbling' problems.

Audio Computers,
Southend-on-Sea,
Essex.

■ **The ZX-81 power-pack was tried without success on the Audio Ram pack reviewed. As all the power is fed through the edge connector Audio's improvements may solve this.**

Audio's own installation notes read: "You might find you tend to lose data after 6pm. This is because the drop in the mains voltage in your area is too critical".

Altering mains power packs is dangerous if you do not know what you are doing, so we did not recommend this modification to those who did build the kit.

Stephen Adams.

CUBE CORRECTION

The Cubemaster program from February *Your Computer* is the oest software-listing I have yet seen for the ZX-81. Unfortunately, a couple of bugs crept in.

Line 550 should read

```
LET C$ = "RBWGYO"
```

and in lines 4280, 4290, 4300 and 4310 the space should be taken out five characters back from the edge of the listings, that is the LS, LS, US and US should be closed up in the four lines.

Graham Mitchell,
Bromborough,
Wirral.

SILENT RUNNING

Since submitting the Silent Running program for the March publication I have discovered that the earlier ZX-81s had a faulty ROM which gave an inaccurate value for .25 ** 2. Recently Sinclair has modified the ROM to give the correct answer, but in doing so has moved some of the subroutines including the one in my program for initialising the submarine's position CD 19 15.

A book by Ian Logan claims that this routine is moved up the ROM by four bytes and now begins at 15 1D. So if anyone has had difficulty in running this program perhaps they would like to correct the listing for their ZX-81 to read:

```
16585 CD 1D 15
      3E 21
      CD 1D 15
```

S A Nicholls,
Kenysham,
Bristol.

FEMINIST INPUT?

Why is microcomputing a *male* preserve? There were 13 girls at Surrey's Reigate County in 1956 doing A-level mathematics, and only nine boys at the Grammar school. The very first person to go through our school in 1904, graduated with a mathematics degree 10 years later and taught it until she retired in 1956. The applications of a micro for women are wide.

I am no longer married, but in my experience most women handle the budget, fill in tax forms, rent and rate rebate forms; keep a stock of food, cleaning materials, children's play materials — a list of stock which would make an office manager reel in disbelief.

As soon as I can, I shall write programs, cover all these areas and some for my daughters to use for their needs. Perhaps in a few months I shall write an article entitled "Micros — a feminist input".

Carol Whiteside,
Alfred Road,
London. ■

Purpose-designed recorder aims to make light of loading

THE ECR-81 is a cassette recorder designed specifically for microcomputers such as the Sinclair ZX-80/81. It is fitted with a long-life head suitable for TDK high-bias Super Avilyn cassette tapes. Output level is preset, eliminating the need for volume adjustment. A write-protect microswitch avoids data loss through accidental tape erasures.

The controls include fast forward and rewind tape search. Supplied with mains lead, DIN connector and certification tape, the ECR-81 costs £47.50 including VAT from Monolith Electronics Co Ltd, 5 to 7 Church Street, Crewkerne, Somerset. Telephone 0460-74321.



Monitor for Sinclair

A VDU HOUSING designed specially for the ZX-81 has been introduced by Crofton Electronics Ltd. The unit comprises a refurbished 9in. Motorola monitor complete with its own power supply, a full-size QWERTY keyboard and the housing itself.

The keyboard incorporates a video amplifier which allows output to be fed directly to the video monitor. Two 3.5mm. jack sockets are provided for the connection of a tape recorder.

A ZX-81, 16K RAM pack and power supply will all fit inside the housing. A mains terminal block enables customers to use their own power supplies to run the ZX-81.

The housing costs £80 plus VAT with a used cathode-ray tube, or £90 plus VAT with a new tube. Anyone wishing to buy the housing with a ZX-81 already installed will be charged an additional £7.50, and will have to part-exchange his own ZX-81 and power supply.

Crofton Electronics Ltd is based at 35 Grosvenor Road, Twickenham, Middlesex, TW1 4AD. Telephone 01-891 1923/1513.

Tigress has triplets

THE TIGRESS, a triple-processor microcomputer, is being released on to the British market by Tangerine. A disc version running CP/M should be available towards the end of the first quarter of 1982, together with a number of standard CP/M software packages. A non-disc version, costing between £600 and £800, will also be released shortly.

A Z-80A with 64K RAM runs a disc-operating system such as CP/M, with a 6809 chip handling I/O and a dedicated graphics processor. The graphics processor controls a display memory of 96K RAM which is completely programmable.

The 6809 chip is loosely coupled to the Z-80A via a full-duplex eight-bit parallel port. Both the Z-80A and 6809 system buses are available for expansion and the 6809 is compatible with Microtan peripheral boards.

The Tigress will be sold by Tandata Marketing Ltd, Forehill Works, Forehill, Ely, Cambridgeshire, CB7 4AE. Telephone 0353-61161.

Your fingers will do the running at the computer Olympic games

BRITAIN'S first Olympics to be simulated on computer takes place in conjunction with Apple '82 — the national Apple user convention — at the Fulcrum Centre, Slough, Berkshire, on June 5 and 6. The 10 events feature the 100m., 400m., 1500m., 100m. hurdles, long jump, shot put, high jump, discus, javelin and pole vault. Each competition will be projected on to a giant TV screen using graphics operated from the computer keyboard.

Derek Meakin, chairman of the Apple Olympics organising committee, said: "We have chosen as the ultimate test of skill a multi-game program called Olympic Decathlon. It has been written by a computer genius, Timothy Smith, who has created vividly-animated graphics of athletes whose limb movements are controlled by using either a microcomputer keyboard or the games paddles.

"A good deal of skill is needed. In each event you interact with the animation in real time, which means that every second counts. The current world record for the various events is fed into the computer and points are awarded depending on the time it takes to complete the course or the length of the "throw".

Heats for the computer Olympics will be monitored by computer clubs throughout the U.K. Information about the heats and the finals can be obtained from Derek Meakin, Europa House, 68 Chester Road, Hazel Grove, Stockport, Cheshire, SK7 5NY. Telephone 061-456 8383.



Floppy disc for Acorn Atom

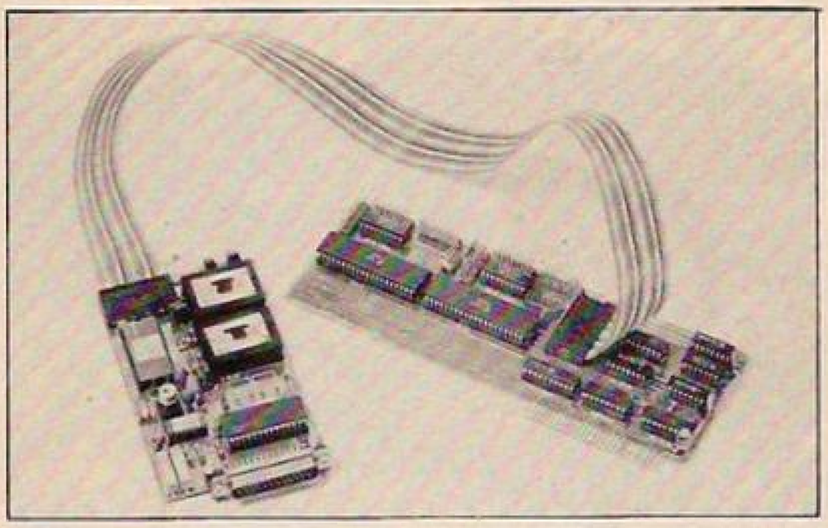
ACORN COMPUTER has launched a 5.25in. mini-floppy disc unit for the Atom. Based on the Olivetti OPE FD-501 drive, the unit costs £345 including VAT and gives 92K of storage on a 40-track single-sided disc. The disc controller uses an Intel 8271 chip while the controller card has 4K DOS ROM and 3K static RAM.

More information is available from Acorn Computer Ltd, 4A Market Hill, Cambridge, CB2 3NJ. Telephone 0223-312772.

ZX-81 booklet

THE RAPID Reference Series booklet for the ZX-81 is designed to complement the official manual. It provides details of the ZX-81 keyboard character positions, print co-ordinates, string functions and graphics character set as well as notes on editing and machine code.

The Rapid Reference Series booklet for the ZX-81 costs 55p — postal order or cheque — from Softest, 10 Richmond Lane, Romsey, Hampshire, SO5 8LA.



The U-A/D interface card for the Apple II includes an eight-channel high-speed 12-bit analogue-to-digital converter, 16 digital I/O lines and four counter timers. The A/D output is buffered and read into the computer via the control board as two eight-bit bytes. The control board provides eight input channels to the A/D and can also accept 16 single-ended inputs. Comprehensive documentation and sample programs are included. Full details from U-Microcomputers Ltd, Winstanley Industrial Estate, Long Lane, Warrington, Cheshire, WA2 8PR. Telephone: 0925-54117.

It's the name that counts with structured Comal-80 language

METANIC COMAL-80, a powerful computer language from Denmark, is now available on the Multiboard System from Gemini Microcomputers Ltd.

Comal-80 contains a full extended Basic and a number of structures found in Pascal which allow the user to define and handle any group of statements as one block. All subroutines are named and each subroutine call uses its name instead of an anonymous line number. User-defined functions can be given long names and may contain as many lines and parameters as required.

Among other advantages, Comal-80 inlcudes free-format input, line-by-line syntax checking and run-time error messages to identify incorrect lines. In total, Comal-80 has more than 3,000 characters of error messages contained in 150 error texts, but these can be deleted to leave the error codes and additional working memory.

Metanic Comal-80 is available on tape or 5.25in. disc for £100 plus VAT from any MicroValue dealer. Further details and a list of dealers can be obtained from Gemini Microcomputers Ltd, Oakfield Corner, Sycamore Road, Amersham, Buckinghamshire. Telephone 02403-28321.

Courses linked to BBC project

THE MICROCOMPUTER Advisory Centre is offering an introductory course in programming for beginners. Micro enthusiasts will be able to practice on a Pet, Apple, BBC or CP/M machine for £2 an hour. The course will be linked with the BBC/NEC computer-literacy project.

A trial course, including an introductory talk, costs £10 for four hours' computing. Two students sharing a microcomputer are offered twice the time.

The Microcomputer Advisory Centre, which was set up by the South Bank Polytechnic last year, is based at Borough Road, London, SE1 0AA. Course details are available from the manager Jack Flatau. Telephone 01-928 8989, extension 2468.

Experts and beginners can benefit from summer school

THE LONDON Computer Summer School is offering a series of weekly courses in microcomputing.

The courses are offered at elementary, intermediate and advanced levels to cater for people with all levels of experience. The elementary course should enable the novice to write simple programs in Basic. It covers an introduction to computer programming, variables and storage, simple loops, flowcharting and an introduction to graphics.

The intermediate course covers subroutines and functions, sequential file handling, matrix commands, sorting, graphics and debugging techniques. The advanced course includes Basic dialects, random-access files, structured programming techniques, introduction to assembler and machine-code programming and interfacing with the real world.

Commodore's Vic-20 is used as the standard machine in the school, with one machine for every two students. Each class has a maximum of 16 students and is taught by a qualified lecturer. Trained assistants are available to help students with practical work.

Anyone over the age of 13 can attend the courses, which are held at Middlesex Polytechnic's Trent Park site in Barnet, Hertfordshire. A brochure describing the courses is available from The London Computer Summer School, Mortimer House, 37-41 Mortimer Street, London, W1N 7RJ. Telephone 01-886 4292.

More for school ZX-81s

AVC SOFTWARE is marketing 12 educational programs for the 16K ZX-81. Seven of the programs are part of AVC's Hangman series and cover British geography, biology and physics. Each of these programs has 50 words, phrases or expressions to guess and contains cryptic graphic or verbal clues. These programs are completely idiot-proof, claims AVC.

Other AVC software includes three programs built around a rocket-launch game — the rocket takes off if all the questions are answered correctly. These countdown programs have three levels of difficulty and cover multiplication tables, English similes and physics exercises.

In addition, AVC offers Angle, which provides practice with a large protractor, Graph, a sophisticated graph-plotting utility, and Madame ZX-81, a fortune-teller for fund-raising events.

More information from AVC Software, PO Box 415, Harborne, Birmingham, B17 0HD.

Software and hardware in U.S. sales and licence agreement

TIMEX IS TO manufacture and market Sinclair's range of microcomputers, peripherals and software throughout the U.S.

Under a new licensing agreement, Sinclair will receive royalties on all sales of its personal computer products in the States. The agreement also covers future developments of Sinclair microcomputers, both by Sinclair and Timex, and the use of Sinclair's own version of Basic.

Sinclair's own U.S. subsidiary will continue to sell the ZX-81 by mail order until Timex sales reach an agreed level. From that point, the Sinclair subsidiary will concentrate on marketing Sinclair's new flat-screen TV, which should be on the market by the last quarter of 1982.

This agreement between Sinclair and Timex extends a partnership which already exists in the U.K. Timex manufactures the ZX-81 at its plant in Dundee, Scotland, where production is currently running at 60,000 units a month, two-thirds for export.

With worldwide sales of the ZX-81 breaking the 300,000 mark in January, and sales of the add-on 16K RAM pack and ZX printer both averaging 10,000 a month, Clive Sinclair said that the new Timex agreement "maintained Sinclair's 1981 pattern of rapid growth into 1982". Sinclair also revealed that company turnover was running at £30 million a year, compared with last year's level of £4.65 million.



SEIKOSHA



The Seikosha GP100A
Manufactured by the Seiko Company, Japan.

The micropriced microprinter

80 col dot graphics for around £215 EX. VAT.

DEALER ENQUIRIES WELCOME

Seikosha introduce the GP100A. A wider and updated version of the highly successful GP80. Now able to take standard width paper, the amazingly compact GP100A offers big printer performance at a fraction of the cost.

With a high quality output that includes full graphics capability, the Seikosha's proven reliability and variety of interfaces make the GP100A the ideal choice for hobbyists, educationalists and businessmen. Full service support is provided by DRG Business Machines' nationwide distributor network.

FEATURES INCLUDE:

- 80 col. 30 cps.
- Dot Matrix unihammer action.
- ACSII standard. 116 characters.
- Full graphics.
- Upper and lower case.
- Double width printing.
- Up to 10" paper width.
- Original + 2 copies.
- Tractor feed.
- Self testing.

INTERFACING for most systems:

- Standard: Centronics.
- Options: RS232C, Serial TTL, 20mA current loop. IEEE-488. Apple II, Sharp (GP100D).

DIMENSIONS:

Depth – 9¼" (234mm)

Width – 17¼" (420mm)

Height – 5¼" (136mm)

OPTIONS:

- Pinch feed.

DRG BUSINESS MACHINES

Birmingham: Microcomputers at Laskeys, (021) 6326303. **Bradford:** Eltec Services Ltd., (0274) 491371. **Bristol:** Microcomputers at Laskeys, (0272) 20421. **Chester:** Microcomputers at Laskeys, (0244) 317667. **Edinburgh:** Microcomputers at Laskeys, (031) 5562914. **Frodsham (nr Warrington):** Northern Computers, (0928) 35110. **Glasgow:** Microcomputers at Laskeys, (041) 226 3349. **Leicester:** Kram Electronics, (0533) 27556. **Liverpool:** Microcomputers at Laskeys, (051) 236 2828. **London:** Microcomputers at Laskeys (W1), (01) 636 0845. **London:** C/WP Ltd. (SW1), (01) 828 3127. **London:** Chromasonic Electronics (N19), (01) 263 9493. **Manchester:** Microcomputers at Laskeys, (061) 832 6087. **Preston:** Microcomputers at Laskeys, (0772) 59264. **Sheffield:** Microcomputers at Laskeys, (0742) 750 971. **Watford:** Watford Electronics, (0923) 40588.

DRG (UK) Ltd, Reg No. 22419 England. (Peripherals & Supplies Division)
13/14 Lynx Crescent, Winterstoke Road, Weston-super-Mare, BS24 9DN. Tel: (0934) 416392.

Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. Each month we will devote the page to new ideas from local clubs. We would like to hear of anything which has made a club a success, or of any projects or programs you are developing.

Send for the Orpington micro brigade



Brendon Gore finds out why a draughty church hall off the Orpington by-pass attracts some of Britain's keenest hobbyists.

ORPINGTON Computer Club has started an associate-membership scheme for microcomputer enthusiasts throughout the U.K. The scheme, which costs £8 a year, allows members to receive the Kent club's newsletter and hardware and software reviews. Yet the scheme's most important benefit is that it allows asociate members to make use of the club's technical advisory service.

Microcomputer users with both hardware and software problems can telephone Roger Pyatt, the club's secretary, seven days a week for advice. If Roger Pyatt cannot answer their queries directly, he will refer them to club members who specialise in such problems. Although the scheme only started in January this year, the club has already received enquiries from as far apart as Manchester and France.

The enthusiasts

The associate-membership scheme is designed for microcomputer enthusiasts who are unable to attend the club's weekly meetings.

Orpington Computer Club meets every Friday at 7.45 pm in a small hall at Christ Church, Charterhouse Road, just off the Orpington by-pass in Kent. Meetings are organised on a bi-weekly schedule. In the first week, between 8.00 and 9.00pm, members have a choice between a beginners' course in Basic and working on programs for the club's software project. A practical session follows where the newcomers attempt to put into practice the lessons of the first session. For more advanced members there is a course on Z-80 machine code.

The second week also offers members a choice of activities. In the first session members can either watch or take part in hardware and software demonstrations, or they can work at their own hardware projects such as making keyboards or analogue control ports.

After the refreshment break, there are either more demonstrations, further work on hardware projects or general discussions on programing and hardware tips.

A monthly newsletter, compiled by chairman Richard White, is distributed free to all members. Reports on some of the latest software and hardware are available for 25p, to cover postage and packaging.

Norman Lambert, head of the club's software group, is putting together an index of software programs.

The club's software reviews consist of a brief description of the program and how it works. The program's packaging, documentation, loading, on-screen instructions, facilities, ease of use, programing technique and usefulness are assessed on a scale from 0 to 10. Members are encouraged to write their own programs.

BBC referral service

Orpington Computer Club is also providing a referral service for the BBC Microcomputer. New and prospective owners of the BBC computers will be directed to the Orpington club.

Most of the club's 40 ordinary members own ZX-80/81s. Other machines owned by club members include a modified Nascom, a TRS-80 and a Superbrain. Richard White has a BBC Microcomputer on order.

The club has established a close relationship with the local branch of W H Smith. Club members help out on Saturdays, demonstrating the ZX-81 and answering technical questions. This benefits both parties, as it provides the staff at W H Smith with a back-up service and provides the club with a source for new members.

The club was only formed in May, 1981, but its credentials are well established. The entertainments officer at Bognor Regis, West Sussex, has contacted the club, asking for advice on how to set up a computer club.

Anyone wishing to join Orpington Computer Club, either as an ordinary or associate member, should write to the secretary, Roger Pyatt, 23 Arundel Drive, Orpington, Kent. ■

Local society news

Hartlepool

THE HARTLEPOOL Amateur Computer Club held its first meeting at the Welfare Hall for the Blind, Hartlepool, on February 26. The club is looking for new members and will welcome anyone who is interested in computers. Full details from the secretary, David Jones, 11 McDonald Place, Hartlepool, Cleveland. Telephone (Hartlepool) 71020 or 66001 after 6.30pm.

BBC Micro User Group

BEEBUG, the recently formed independent user group for the BBC Micro, is launching its own newsletter in April. Devoted exclusively to the BBC Micro, the first issue will contain hardware and software tips, advice on upgrading the basic model, program listings for three-dimensional noughts and crosses and Moonlander and an advice clinic to answer reader's questions. Membership costs £4.50 for six months or £8.50 for one year. For further details send a stamped, addressed envelope to Beebug, 35 St Julians Road, St Albans, Hertfordshire.

Aylesbury ZX Computer Club

THE AYLESBURY ZX Computer Club is designed to help members make the most of their Sinclair computers. The club has a library of software, books and periodicals, and provides a forum for the exchange of ideas, programs and hardware. Guest speakers and informal "teach-ins" cover a range of topics from machine code to members' own four-line programs. Membership costs £5 a year, or £2.50 for under-17s and over-65s. More information from Ken Knight. Telephone 0296 27446 during office hours.

REVIEW

VIC ADD-ONS

Tim Hartnell tests an array of Commodore Vic add-ons which in many cases seem to be as remarkable for their high quality as for their high prices.

THERE IS A bewildering variety of add-ons available for the Vic-20; from a motherboard to U.S. cassette-based software, from joysticks to light-pens. Overall, the standard is good, but most products are marked by one characteristic — a very high price. For example, a cassette of two games — Code-maker and Code-breaker — imported from America retails for £14.95, and Commodore's — in my view very boring — fruit-machine program, Super Slot, sells for an incredible £19.95.

For those who have never used a Vic, connection is simplicity itself. The instructions in the manual are clear, and I immediately obtained a steady picture, with good colour, on exactly the same channel tuning used for my ZX-81 and Atom. The first picture you see tells you how much free memory is available — slightly less than 4K with the standard machine.

Additional cost

The computer costs £189, with the Commodore cassette player an extra £45. The Vic-20 demands its own, special cassette player, which adds to the cost of the basic unit. On the positive side, however, the reliability of Load/Save using the dedicated recorder is as good as any I have seen, including the Atari, and much better than the ZX-81. My only complaint about the computer is the irritatingly short video lead.

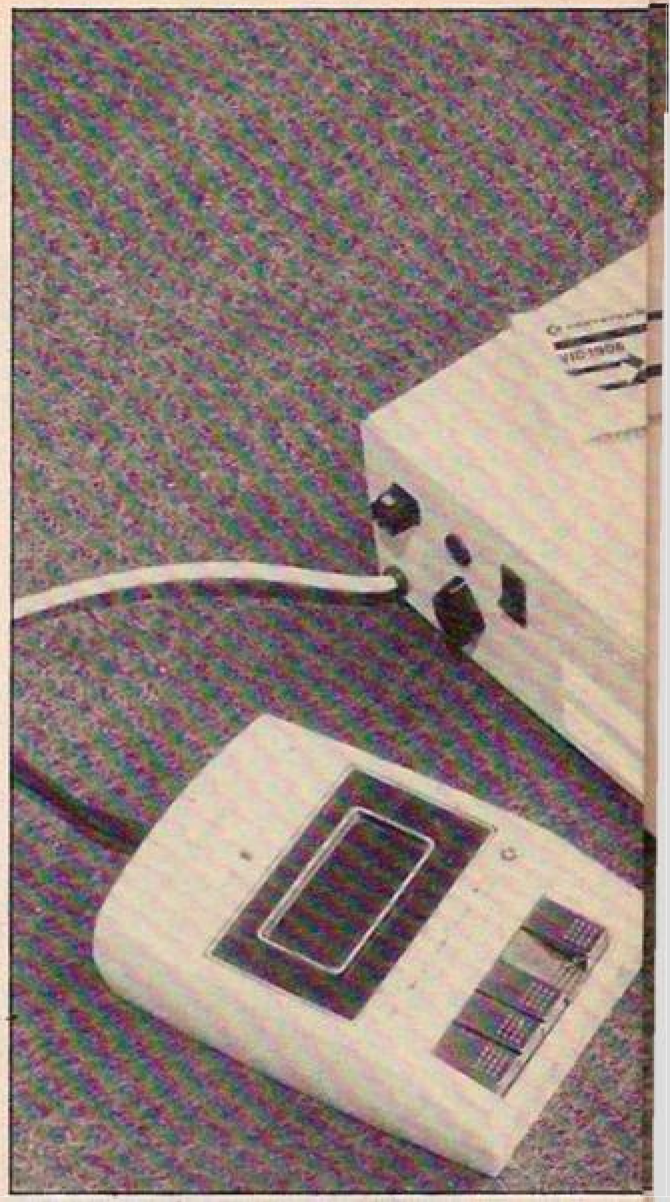
The Vic-20 dot-matrix printer produces a clear printout of programs. All colour commands and graphics are reproduced directly, which makes listings easy to read and re-enter. This tractor-feed printer offering 80 characters per line, 30 characters per second, costs around £230, and while very noisy, is a robust, reliable unit.

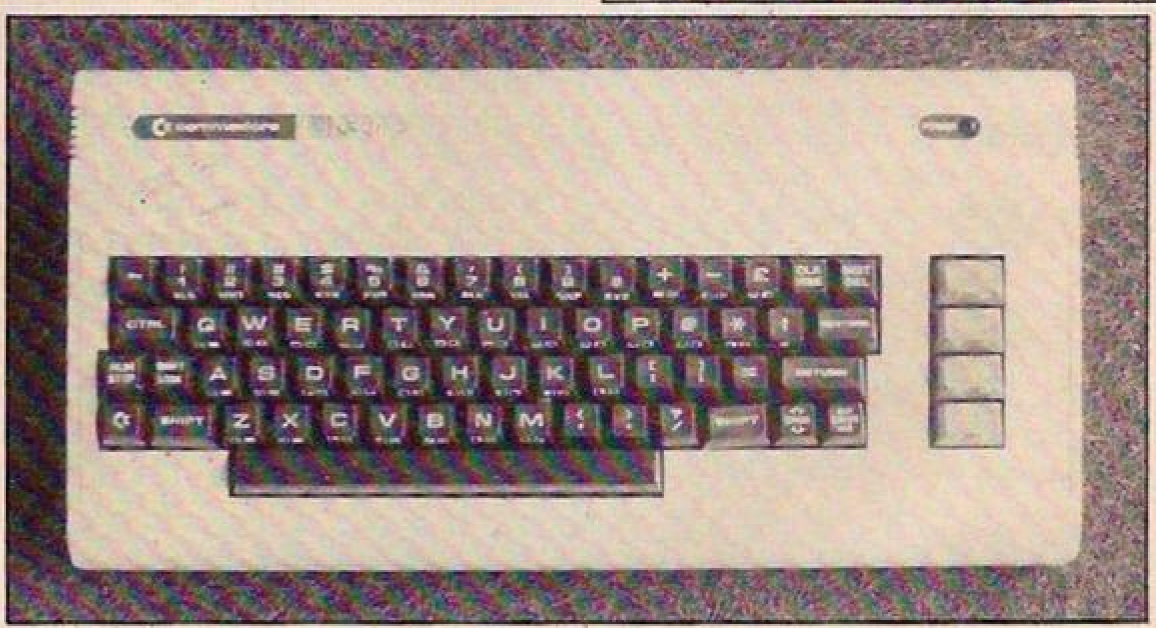
There are a variety of ways you can add memory to the Vic. At the bottom of the range is the 3K plug-in pack, which gives the user a total of 64K for £40.25 — an example of the high prices. This memory board allows the Vic to move the Basic and begin at 1024 — 0400 — as in the Pet, and makes possible the use of high-resolution in colour graphics.

A 19K memory expansion is available for £198 which has 16K battery-protected so that it will store programs for up to a year after turning the computer off. It incorporates a 4K removable module whch has its own battery back-up circuit. There are many more memory options available in two device types: NMOS for lower cost, and CMOS for lower power drain. Each type is offered in three memory sizes with or without a switchable 3K RAM in the lower address space. The CMOS units cost £82 for 8K, £103 for 8K plus 3K, £124 for 16K, £146 for 16K plus 3K, £167 for 24K, and £184 for 24K plus 3K.

Currah Computer Components of Hartlepool has produced a 220M mini-digital recorder which you can use with the Vic-20. The 220M is a non-volatile data storage system based on the Philips mini-digital cassette recorder. It is fully compatible with 6502-based micros, including the Vic. The machine features a read/write speed and data integrity comparable to discs at a fraction of the cost, and you would probably find use for it if you needed a good deal of memory — up to 64K per side, in fact — where access time was not critical.

The unit makes use of 21 extra Basic commands — such as NF "name" for New File, and KF "name" for Kill File — to control the functions of the tape. Although conventional tapes are not reknowned for high reliability, the Currah 220M, when I tested it, seemed to store data with 100 percent accuracy. Further information on the unit is available from Currah on 0429-72996.





Easy to program

The light-pen, which costs between £25 and £30, works in the normal and high-resolution modes on the Vic, allowing interaction with the Vic without using the keyboard. It is relatively easy to program, and after a little practice, effortless in operation. You can use the touch-sensitive "enter" contacts to prevent putting information into the Vic via the pen by accident.

At around £15 each, and resembling Tandy units, the joysticks must be bought as a single, or as a pair. Two singles will not work as a pair unless modified.

I extensively tested four Commodore games cartridges which — like the memory — plug in at the back of the Vic on the right-hand side. Due to some design quirk, the slot at the back is larger than the cartridge, which means that a considerable amount of manipulation of the cartridges is necessary to fit them into place. Once that is done, there are no problems.

All four cartridges tested had a screen-adjust feature when first booted up, so you could use the cursor keys to position the picture exactly where you wanted it. The cartridges are attractively packaged with coloured pictures and two or three pages of instruction each. Despite their high price of £19.95, many Vic owners are sure to find they are a good investment.



Your task in Superlander is to set down successfully a very odd-looking spacecraft on the surface of a pock-marked planet. The simplest site is worth two points, the one with the middle degree of difficulty five points, and there are 10 points if you manage to land in the most difficult spot. The game is good to play, as the response from the function keys is immediate. The key f1 is for maximum thrust, f2 for medium and f3 for low thrust; the A key moves lander to the right, and D moves the craft to the left. The reaction of the spacecraft gives a good simulation of a body moving in space. It is extremely difficult to play.

In a number of games, I managed to land only once without exploding, and even then it was just on the easiest site — my landing was not good enough to gain bonus points. A frustrating game to play, and one in which you would probably lose interest once you had mastered it.

As with the other programs, the sound effects seemed to have been added as an afterthought. The graphics on all the packs tested were superb, but the sound generally consisted of one or two subroutines which were called endlessly during the game.

Worst cartridge

Super slot, a fruit machine with very good high-resolution graphics, was, in my opinion, the worst cartridge of all. You have no influence whatsoever on the outcome of the game; there are no hold or nudge facilities; all you can do is enter C for coin for each direction you wish to be a pay-off, and then press P to start the game. Interestingly, this game is the one which was demonstrated on the Vic seen in the first program on the BBC's *Computer Programme.* Fortunately for Commodore, the game was not examined closely, and the sound was turned off.

In Alien, you fight off a number of little red beasties, who pursue you around a maze of green slabs. You have three minutes of each game in which to find and destroy all the aliens, which you do by burying them when they fall into holes you have cleverly dug. You have three lives, and the P, L, . and ; keys move you around the maze; the A digs holes and D fills them in. It is a good game to play, and one which I would have liked more time to master. This and Superlander tie, in my opinion, for equal second place of the four cartridges tested.

High-score feature

Avenger, — an almost standard Space Invaders — is far and away the best. Better-than-average use of sound enlivens a version of the pub favourite. The high-score feature encourages repeated plays, and as you spend longer with the program, you are rewarded by gradually improving your skill.

There are three types of aliens, worth 10, 20 and 30 points each, with the mothership appearing amid much bleeping on the loudspeaker once or twice a game. The mothership is worth a different number of points each time it is hit. You win a bonus laser base if you manage to top 1,500 points. This game is a good one to play with the joystick.

Arfon Micro produces the Vic Expansion Unit, which incorporates a new, more robust power supply, motherboard with seven cartridge sockets, and a 24V output for the Arfon Printer. The cassette port and disc port are still totally usable, as are the joysticks. The modulator is held neatly at the rear of the expansion board.

All this is splendidly packaged in an aluminium shell which fits behind the Vic-20, allowing a monitor to sit on top of the unit. Arfon produces 3K, 8K and 16K RAM cartridges, as well as cartridges for music, speech and a clock. Total memory can be increased to nearly 30K with the Expansion Unit.

For about £50, you can use this interface to enable your Vic to drive a Qume daisywheel or a paper-tape puncher. The interface contains a power unit which can double the Vic's ability to support add-ons. It also has an external socket to allow the supply voltages +5V, +15V, −15V to be used for other devices such as the light-pen or printer.

Low-cost interface

For less than half the price of this unit, there is a low-cost, bi-directional RS-232 interface which is configured as a conventional pin-out to a 25-way D-type connector.

The £40 ROM Switchboard plugs directly into the memory expansion port to allow you to call up to four ROMs. It is particularly useful with the Vic toolkit — a £30 chip which gives the Vic programmer access to a similar set of commands as provided by the Pet toolkit, including Append, Auto and Renumber.

There is a whole range of additional Vic products available, such as a £18 port adaptor cable, a user-port splitter, a £33 games port multiplexor, which connects to the games port of the Vic and multiplexes pot X and pot Y lines under software control to allow multiple joysticks to be used. The range of cassette tapes seem expensive at £14.95 each: Codebreaker/Codemaker; Seawolf/Trap/Bounce-out and Monster Maze/Maths Hurdler. There are three books for the Vic owner: Nick Hampshire's *Vic Revealed,* which costs £10; *Learn Computer programming with the Commodore Vic,* by L R Carter and E Huzan for £1.95 and my own *Getting Acquainted With Your Vic-20,* £5.95.

CONCLUSIONS

- It is unfortunate that the prices of Vic add-ons and software seem higher, in some instances, than similar products for other computers of a similar price range. This may well be due to the slightly smaller market that the Vic enjoys compared with other computers in its class.
- The Vic is — apart from the broad graphics — an exceptionally well-designed machine, which invites programming experimentation.
- The value of the Vic is undoubtedly enhanced by the range of products now available for it.
- The computer and additional products were provided for this review by Adda Computers Limited, The Vic Centre, 154 Victoria Road, Acton, London, W3. ■

BUG-BYTE SOFTWARE

ZX81 ATOM

ZX81

ADVENTURES

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Program Pack 3 (1K)	£4.50
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GOLF	6K FP	£5.00
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2K PROGRAMS	1, 2 & 3 (each)	£4.50

FP = FLOATING POINT ROM NEEDED

BUG-BYTE SOFTWARE

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THE BEEBON

A new magazine devoted exclusively to users of the BBC Micro, containing tested programs, features on programming, hardware, etc., reviews and much more. At least three substantial programs in each issue, written by professional programmers. Published every two months starting in May. Annual subscription (6 issues) £7.50.

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VICGAMMON (3K expansion)	£7.00

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ADVENTURE



Adventure is the most popular microcomputer game. Although bought Adventures satisfy most appetites, many prefer to "grow their own". Graham Thomson provides budding Adventure authors with a complete Adventure kit for the ZX-81, enabling them to populate the computer world with their own demons.

IN THE DECEMBER 1981 issue of *Your Computer* my article on ZX-81 strings attempted to show how programs can be made more flexible by using the functions Code and CHR$ to build lists and chains in a Dimensioned string. That article ended by saying that one example of the use to which I had put the techniques was a general-purpose Adventure program. Here is that program.

All Adventure games have the same fundamental structure. By means of one- or two-word instructions to the computer, the player moves from place to place in the Adventure scene — which may be a magic cave with a maze of passages and caverns, a haunted house with many rooms and corridors, or an ancient city with houses, alleys and winding streets.

As you move from one place to another, the computer prints a description of the place you have reached, and the directions, north, south, east, west, top or down, that you can travel from there. At some of the places there are objects — treasure, keys and weapons. Some are useless; some score points if you can carry them back to a base; some are needed to pass obstructions placed in your path — locked doors and monsters, for example.

Thus, to make a general-purpose Adventure program the minimum requirement is a program to which we can describe:

- The places.
- The links between places — north, south, east, west, up or down.
- The objects and where they lie.

The program must recognise key words and take the correct action. For example, north means move from the current place to wherever, if anywhere, we reach by travelling north. "Get keys" mean pick up the keys and carry them. "Drop keys" means drop the keys at this place — if you are carrying them.

The Adventure-writing kit should, therefore, include the facility to build a dictionary of words and associated line numbers for the routines to process.

These are the basic functions of the program, so let us look at the program itself which is in ZX-81 Basic. First, the main variables:

O$(5000) is the string in which the descriptions of objects and places, and the list of words are built. Figure 1 shows the format of an entry describing a place. Figure 2 is the format for an object entry and figure 3 for a word entry.

O$(31) holds the two-byte binary indices which lead into S$ for the object entries. The index to object number O is

256* CODE(O$(2*O)) + CODE O$(2*O + 1)

So the first byte is unused and there is space for 15 objects.

P$(101) holds the two-byte binary indices which lead into S$ for the place entries. The index to place P is

256* CODE(P$(2*P)) + CODE P$(2*P + 1)

As with O$, the first byte is unused, so there is space for 50 places.

F is the next free byte pointer in S$. This is initialised to 3, because the first two bytes of S$ are reserved: S$(1) is unused; S$(2) is the number of the first object being carried.

S accumulates points scored for reaching given places or for carrying treasure back to base.

W1 is the address — the index in S$ — of the first word entry, or head of chain.

W2 is the index to the last word entry, or the tail of the chain.

P is the number of the current place.

IP is the index into S$ of the current place entry.

Z$, X$ and Y$ are used to input and process the commands. Z$ is the full command, X$ the first word, Y$ the second word.

O is an object number.

IO is the index to the object O.

The main sections of the program are:

10 to 530: initialisation. They control the definition of the game, and start the game.

1000 to 1220: the main control for the game — they input and analyse the commands.
1400 to 1440: the subroutine to assist in command analysis by finding the next space in the command.
1500 to 1751: the subroutine to search the word chain for a match with X$ — it accepts the first four characters as a match — and then returns with L set to the line number for processing this word, or with L set to zero if the word is not in the list. Lines 1720 to 1751 vary the response to an invalid command.
2000 to 2240: they handle the move from one place to another — the commands north, south, east, west, up or down.
2300 to 2330: these lines handle the Stop command which halts the game.
2350 to 2430: handle the Save command which suspends the game. Note that line 2340 is the entry for a Save during initial set-up of the game.
2500 to 2540: handle the Help command.
2800 to 2930: handle the Drop command.
3000 to 3120: handle the Get command which picks up objects.
3200 to 3220: handle the Score command.
3300 to 3360: handle the List command which reminds you what you are carrying.
4000 to 4180: during the set-up of game, these lines handle definition of a word and the associated line number.
4500 to 4830: during set-up, these lines handle definition of an object.
5000 to 5295: during set-up, these lines handle definition of a place.
5300 to 5350
and
5500 to 5700: the subroutines for defining descriptions and scores for places and objects.
5800 to 5820: set IP.
5900 to 5920: set IO.
6000 to 6170: the subroutine used by Drop and Get to move an object from the chain of objects being carried to the chain of objects at this place, or vice versa.
6500 to 6690: search the chain of objects being carried, or, at this place, for the one named in Y$.
6700 to 6780: print the long description for this place — P and IP.
6800 to 6830: print the short description for this place.
6900 to 7020: print the list of objects at this place, or being carried.

To set up a new Adventure game draw a diagram of your network of places, allocating a number to each place. Use number 1 for the home base — the place to which treasure must be brought to gain points. This does not need to be the starting point for the game.

Then decide which objects are involved and where they are to be at the start of the game. If you want to introduce any special words, write the code to handle them — the line numbers after 7020 are available for this purpose. The code for each special word must finish with Return. If you need to Print any messages, remember to Scroll first.

When you run the program, you will see a request asking what you want to do next — the options are:

- Places: define places.
- Objects: define objects.
- Words: define words.
- Go: start the game.
- Save: save what you have so far to cassette.

Select the Words option and define the following words and associated line numbers.

Word	Line to Goto	
N	2000	North
S	2020	South
E	2040	East
W	2060	West
U	2080	Up
D	2100	Down
Get	2800	
List	3300	
Help	2500	
Look	6700	
Save	2350	
Stop	2300	

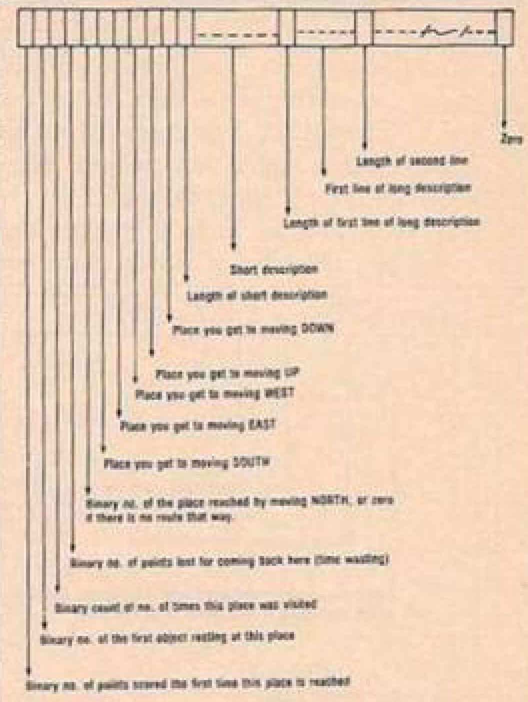


Figure 1.

Indicate the end of the list of words by entering 99. It is a good idea to select the Save option now so that you do not have to re-enter this fixed list of words for every game you define. After the Save, you can then reselect Words and continue defining any special words of your own. Note that you can make the game more friendly by including synonyms — say, both North and "N".

The order of entry of the words is the order of the search during command analysis, so put the most commonly-used ones first, as shown.

Then select the Places option, and define your network. This option asks for the place number, a short description of the place, a long description, a score — which is the number of points gained for reaching this place — the number of points lost for returning to it, and the numbers of the places reached by going N,S,E,W,U or D.

(continued on next page)

```
10 DIM S$(5000)
20 DIM O$(31)
30 DIM P$(101)
40 LET S$(1 TO 2)="  "
50 LET F=3
55 LET S=0
60 LET W1=S
65 LET W2=S
70 CLS
75 PRINT "F IS ";F
80 PRINT "WHAT NEXT?"
90 PRINT "PLACES,OBJECTS,WORDS,GO,SAVE"
100 INPUT Z$
110 IF Z$="PLACES" THEN GOSUB 5000
120 IF Z$="OBJECTS" THEN GOSUB 4500
130 IF Z$="WORDS" THEN GOSUB 4000
140 IF Z$="GO" THEN GOTO 500
145 IF Z$="SAVE" THEN GOSUB 2340
150 GOTO 70
500 PRINT "WHAT IS THE STARTING PLACE NO."
510 INPUT P
520 GOSUB 5800
530 GOSUB 6700
1000 INPUT Z$
1010 SCROLL
1020 PRINT Z$
1030 LET X$=" "
1040 LET Y$=" "
1050 IF Z$="" OR Z$=" " THEN GOTO 1000
1060 LET I=1
1065 LET Z=LEN Z$
1070 GOSUB 1400
1080 LET X$=Z$(1 TO K-1)
1090 LET I=K
1100 IF I>Z THEN GOTO 1200
1110 IF Z$(I)<>" " THEN GOTO 1140
1120 LET I=I+1
1130 GOTO 1100
1140 GOSUB 1400
1150 LET Y$=Z$(I TO K-1)
1200 GOSUB 1500
1210 IF L>0 THEN GOSUB L
1220 GOTO 1000
1400 LET K=I
1410 IF Z$(K)=" " THEN RETURN
1420 LET K=K+1
1430 IF K<=Z THEN GOTO 1410
1440 RETURN
1500 LET I=W1
1510 LET J=LEN X$
1520 LET L=CODE S$(I+4)
1530 IF L<>J THEN GOTO 1550
1540 IF S$(I+5 TO I+4+L)=X$ THEN GOTO 1600
1550 IF J<4 OR L<4 THEN GOTO 1570
1560 IF S$(I+5 TO I+8)=X$(1 TO 4) THEN GOTO 1600
1570 LET I=256*CODE S$(I) + CODE S$(I+1)
1580 IF I=0 THEN GOTO 1710
1590 GOTO 1520
1600 LET L=256*CODE S$(I+2) + CODE S$(I+3)
1700 RETURN
1710 LET L=0
1720 LET I=INT (5*RND+1)
```

(listing continued on next page)

(continued from previous page)

The short description is one line only, and is limited to 21 characters. The long description is as many lines as you like — indicate the end of it, by entering End. For those directions which are invalid, enter zero as the place number you reach by going that way.

It is a good idea to include in the long description an indication of which routes are accessible. When you have finished entering place, reply 0 to the "Place no.?" prompt.

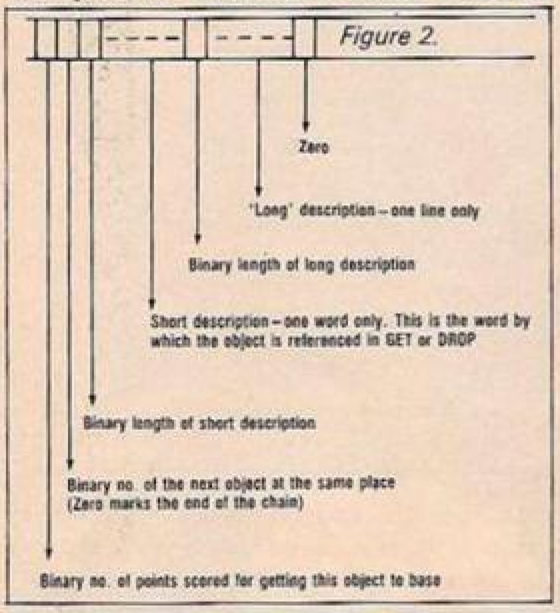


Figure 2.

Now select the Objects option and define your objects. This option asks for the object number, a short description of one word only, a long description of one line of up to 32 characters, the score for carrying it back to base, and the initial place number for the object. When you have defined all the objects, enter 0 in reply to the "Object no.?" prompt.

When you now select the Go option, the program asks for the starting place number, prints the description, and waits for a command. When you have completed all that, enter Save so that the program copies itself on to the cassette. Whenever you reload your game, it will not start automatically by printing the description of the starting location.

As the game progresses, the long description is printed for the first time a place is reached. Thereafter, any return to the same place produces the short description.

You may want to build further program code to trap certain actions. For example, dropping fragile objects, or moving into dark places without a torch. Intercept points are indicated in the listing by Rem statements:

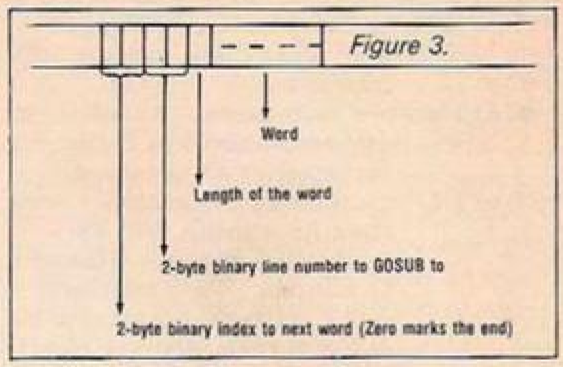


Figure 3.

2135	A — you are about to move from place number P to place number I.
2200,2220	B1, B2 — you must intercept at both — you have just arrived at place number P.
2890	C — you are about to Get object O.
3090	D — you are about to Drop object O.

In the cases of the "about to move, get or drop", if your additional code executes a Return, the action is cancelled. Otherwise your intercept code must end with a Goto on the line after the intercept. Activate your code by overwriting the Rem with a Goto.

The program leaves you slightly more than 4K on the 16K ZX-81 for your own code, or you could increase the sizes of S$, O$ and P$.

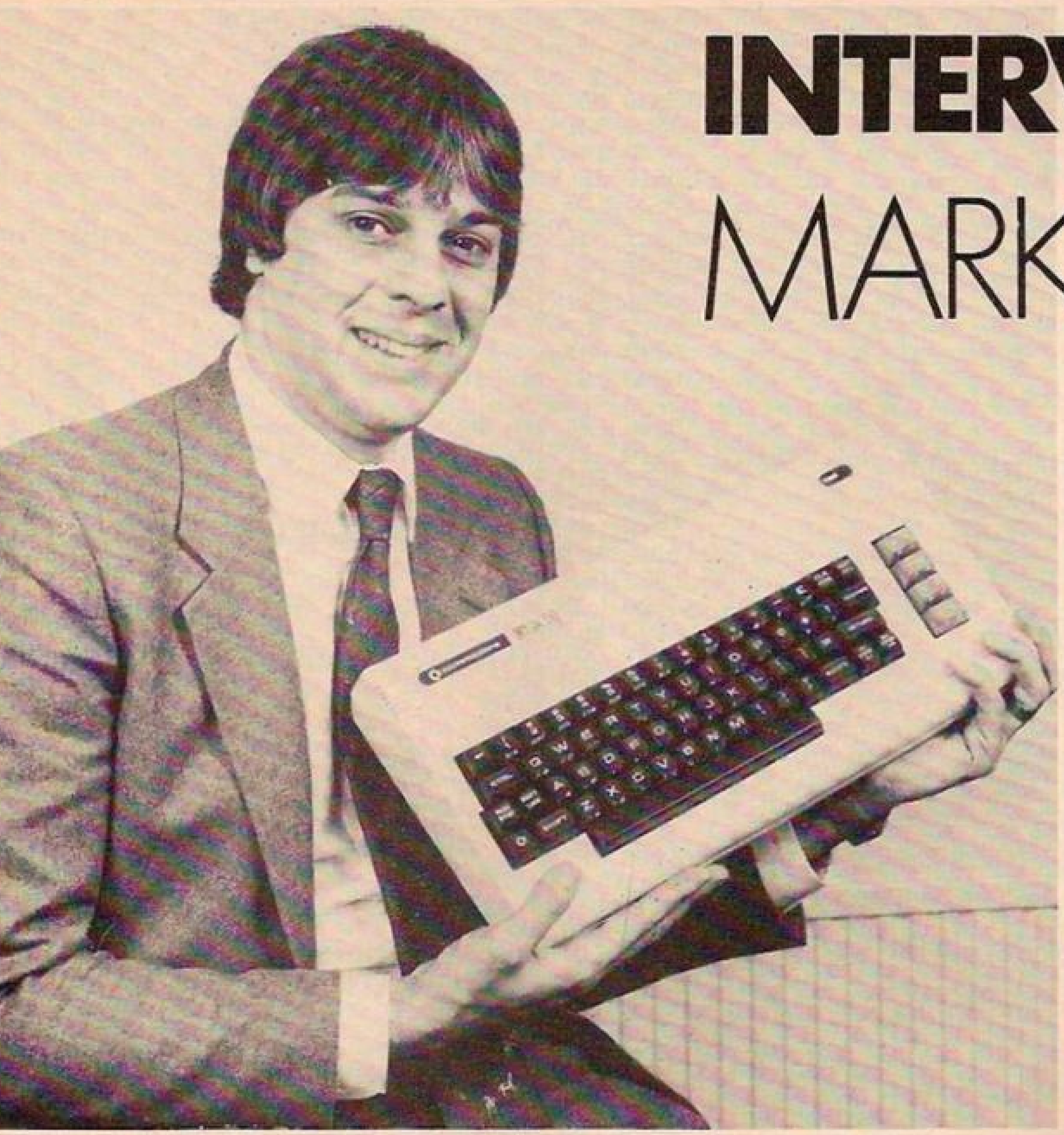
(listing continued from previous page)

```
1730 SCROLL
1740 GOTO 1740+2*I
1742 PRINT "WHAT?"
1743 RETURN
1744 PRINT "SORRY, I DON'T UNDERSTAND THAT"
1745 RETURN
1746 PRINT "TRY ANOTHER WORD"
1747 RETURN
1748 PRINT "EH?"
1749 RETURN
1750 PRINT "WHAT DO YOU MEAN?"
1751 RETURN
1999 REM MOVE N,S,E,W,U,D
2000 LET I=4
2010 GOTO 2110
2020 LET I=5
2030 GOTO 2110
2040 LET I=6
2050 GOTO 2110
2060 LET I=7
2070 GOTO 2110
2080 LET I=8
2090 GOTO 2110
2100 LET I=9
2110 LET I=CODE S$(IP+I)
2120 SCROLL
2130 IF I=0 THEN GOTO 2230
2135 REM INTERCEPT A
2140 LET P=I
2150 GOSUB 5800
2160 LET A$=CHR$ (CODE (S$(IP+2))+1)
2170 LET S$(IP+2)=A$
2180 IF A$=" " THEN GOTO 2210
2185 LET S=S-CODE S$(IP+3)
2190 GOSUB 6800
2200 REM INT. B1
2205 RETURN
2210 GOSUB 6690
2215 RETURN
2220 REM INT. B2
2230 PRINT "SORRY, YOU CAN'T GO THAT WAY"
2240 RETURN
2300 SCROLL
2310 PRINT "OK. USE CONT TO RESTART"
2320 STOP
2330 GOTO 6700
2340 LET X$="INIT"
2350 SCROLL
2360 PRINT "SETUP THE TAPE; TYPE NAME TO USE"
2370 SCROLL
2380 PRINT "START TAPE; TYPE NEWLINE"
2390 INPUT A$
2400 SAVE A$
2410 CLS
2420 IF X$<>"INIT" THEN GOTO 6700
2430 RETURN
2500 SCROLL
2510 PRINT "ALL I CAN DO TO HELP IS REPRINT"
2520 SCROLL
2530 PRINT "THE DESCRIPTION OF THIS PLACE."
2540 GOTO 6700
2800 IF Y$<>" " THEN GOTO 2840
2810 SCROLL
2820 PRINT "GET WHAT?"
2830 RETURN
2840 GOSUB 6520
2850 IF O>0 THEN GOTO 2890
2860 SCROLL
2870 PRINT "I SEE NO ";Y$
2880 RETURN
2890 REM INT. C
2895 GOSUB 6030
2900 IF R=0 THEN GOTO 2860
2904 IF P=1 THEN LET S=S-CODE S$(10)
2910 SCROLL
2920 PRINT "OK"
2930 RETURN
3000 IF Y$<>" " THEN GOTO 3040
3010 SCROLL
3020 PRINT "DROP WHAT?"
3030 RETURN
3040 GOSUB 6500
3050 IF O>0 THEN GOTO 3090
3060 SCROLL
3070 PRINT "YOU HAVE NO ";Y$
3080 RETURN
3090 REM INT. D
3095 GOSUB 6000
3100 IF R=0 THEN GOTO 3060
3110 IF P=1 THEN LET S=S+CODE S$(10)
3120 GOTO 2910
3200 SCROLL
3210 PRINT S
3220 RETURN
3300 LET O=CODE S$(2)
3310 SCROLL
3320 IF O>0 THEN GOTO 3350
3330 PRINT "YOU AREN'T CARRYING ANYTHING"
3340 RETURN
3350 PRINT "YOU HAVE :"
3360 GOTO 6950
4000 CLS
4005 FOR I=1 TO 10
```

```
4010 PRINT "WORD?";
4020 INPUT A$
4025 PRINT A$
4030 IF A$="99" THEN RETURN
4040 IF A$="" THEN GOTO 4020
4050 IF W1=0 THEN LET W1=F
4060 IF W2=0 THEN GOTO 4090
4070 LET A=INT (F/256)
4080 LET S$(W2 TO W2+1)=CHR$ A+CHR$ (F-256*A)
4090 LET S$(F TO F+1)="  "
4100 LET A=LEN A$
4110 LET S$(F+4)=CHR$ A
4120 LET S$(F+5 TO F+4+A)=A$
4125 PRINT "LINE NO. TO GO TO?";
4130 INPUT N
4135 PRINT N
4140 LET B=INT (N/256)
4150 LET S$(F+2 TO F+3)=CHR$ B+CHR$ (N-256*B)
4160 LET W2=F
4170 LET F=F+5+A
4175 NEXT I
4180 GOTO 4000
4500 CLS
4510 PRINT "OBJECT NO.?";
4520 INPUT O
4525 PRINT O
4530 IF O<=15 THEN GOTO 4560
4540 PRINT "TOO HIGH"
4550 GOTO 4510
4560 IF O<=0 THEN RETURN
4565 LET IO=F
4570 LET G=F
4580 LET A=INT (G/256)
4590 LET O$(2*O TO 2*O+1)=CHR$ A+CHR$ (G-256*A)
4600 LET F=F+2
4700 GOSUB 5500
4710 LET S$(G+1)=CHR$ 0
4770 PRINT "1ST PLACE FOR IT?";
4780 INPUT P
4790 PRINT P
4800 GOSUB 5800
4810 LET S$(2)=CHR$ O
4820 GOSUB 6000
4830 GOTO 4500
5000 CLS
5010 PRINT "PLACE NO.?";
5020 INPUT N
5023 PRINT N
5025 IF N<=50 THEN GOTO 5030
5026 PRINT "TOO HIGH"
5027 GOTO 5010
5030 IF N<=0 THEN RETURN
5035 LET G=F
5036 LET A=INT (G/256)
5037 LET P$(2*N TO 2*N+1)=CHR$ A+CHR$ (G-256*A)
5040 LET F=F+10
5050 GOSUB 5500
5170 PRINT "LOSE 2ND?"
5180 INPUT A
5190 LET S$(G+3)=CHR$ A
5200 LET S$(G+1 TO G+2)="  "
5220 LET A$="NSEWUD"
5230 CLS
5240 PRINT "PLACES YOU GET TO?"
5250 FOR I=1 TO 6
5260 PRINT A$(I);
5270 INPUT A
5275 PRINT A
5280 LET S$(G+3+I)=CHR$ A
5290 NEXT I
5295 GOTO 5000
5300 PRINT A$
5310 LET L=LEN A$
5320 LET S$(F)=CHR$ L
5330 LET F=F+1+L
5340 LET S$(F-L TO F-1)=A$
5350 RETURN
5500 PRINT "SHORT DESCRIPTION?"
5510 INPUT A$
5515 LET F1=F
5520 GOSUB 5300
5530 PRINT "LONG?"
5540 INPUT A$
5550 IF A$="END" THEN GOTO 5590
5560 IF A$="" THEN GOTO 5540
5570 GOSUB 5300
5580 GOTO 5540
5590 PRINT "DO YOU WANT TO RETYPE ABOVE?"
5600 INPUT A$
5610 IF A$(1)="N" THEN GOTO 5640
5620 LET F=F1
5630 GOTO 5500
5640 LET S$(F)=" "
5650 LET F=F+1
5660 PRINT "SCORE?";
5670 INPUT A
5680 PRINT A
5690 LET S$(G)=CHR$ A
5700 RETURN
5800 LET IP=P*2
5810 LET IP=256*CODE P$(IP)+CODE P$(IP+1)
5820 RETURN
5900 LET IO=O*2
5910 LET IO=256*CODE O$(IO)+CODE O$(IO+1)
5920 RETURN
5999 REM DROP
6000 LET I=1
6010 LET K=IP
6020 GOTO 6050
6029 REM GET
6030 LET I=IP
6040 LET K=1
6050 LET A$=CHR$ O
6060 LET R=0
6070 LET B$=S$(I+1)
6080 IF A$=B$ THEN GOTO 6130
6090 IF B$=" " THEN RETURN
6100 LET J=2*CODE B$
6110 LET I=256*CODE O$(J)+CODE O$(J+1)
6120 GOTO 6070
6130 LET S$(I+1)=S$(IO+1)
6140 LET S$(IO+1)=S$(K+1)
6150 LET S$(K+1)=A$
6160 LET R=1
6170 RETURN
6500 LET IO=1
6510 GOTO 6530
6520 LET IO=IP
6530 LET O=CODE S$(IO+1)
6540 IF O=0 THEN RETURN
6550 GOSUB 5900
6560 LET L=CODE S$(IO+2)
6570 LET A$=S$(IO+3 TO IO+2+L)
6580 IF L<>LEN Y$ THEN GOTO 6610
6590 IF A$=Y$ THEN RETURN
6600 GOTO 6530
6610 IF LEN Y$<4 THEN GOTO 6530
6620 IF A$(1 TO 4)=Y$(1 TO 4) THEN RETURN
6630 GOTO 6530
6690 LET S=S+CODE S$(IP)
6700 SCROLL
6710 PRINT "YOU ARE IN:"
6720 LET I=IP+CODE S$(IP+10)+11
6730 LET L=CODE S$(I)
6740 IF L=0 THEN GOTO 6900
6750 SCROLL
6760 PRINT S$(I+1 TO I+L)
6770 LET I=I+L+1
6780 GOTO 6730
6800 SCROLL
6810 PRINT "YOU ARE IN ";
6820 LET L=CODE S$(IP+10)
6830 PRINT S$(IP+11 TO IP+10+L)
6900 LET IO=IP
6910 LET O=CODE S$(IO+1)
6920 IF O=0 THEN RETURN
6930 SCROLL
6940 PRINT "THERE IS HERE :"
6950 GOSUB 5900
6960 LET I=IO+3+CODE S$(IO+2)
6970 LET L=CODE S$(I)
6980 SCROLL
6990 PRINT S$(I+1 TO I+L)
7000 LET O=CODE S$(IO+1)
7010 IF O=0 THEN RETURN
7020 GOTO 6950
```

INTERVIEW

MARKETING



As the Vic-20 hits the U.K. market in volume, Brendon Gore talks to John Baxter, Commodore's marketing manager. More than anyone, he will decide when we will be able to buy the new Vic-40 and Ultramax micros.

MICROCOMPUTERS are a relatively new subject for John Baxter, Commodore's U.K. marketing manager. He started work as a management trainee for IPC, the periodical publishers, in the magazines department. During his stint at IPC he looked after a range of publications including the *Eagle* of Dan Dare fame, *New Musical Express, New Scientist* and *New Society*.

John Baxter then moved on to an advertising agency, Chetwynd-Haddons, before joining Whitbread as group marketing manager for the soft drinks division. Yet despite spending seven years with Whitbread, handling everything from Pepsi Cola to R White's lemonade, he felt that he wanted more of a challenge.

"I had a wonderful job at Whitbread and I have no complaints about the company at all, but in the end I didn't find soft drinks exactly the most exciting market in the world", says Baxter.

An approach to Commodore led to an interview with Kit Spencer, Commodore's former general manager. The result was a switch from soft drinks to microcomputers.

"I don't claim to have any significant computer awareness of computer knowledge", says John Baxter. "I don't know how a chip works, I only know what it does. I'm not a programmer by any means, I've only learnt a smattering of Basic since I've been here, but I joined Commodore because I wanted to get into this kind of high-technology development area".

John Baxter's move to Commodore coincided with the company's plans for launching the Vic-20 on to the U.K. market. Unlike the Pet, the Vic-20 was aimed at the home and particularly the first-time user. It is still too early to judge its success, but the initial response has been encouraging.

In some ways the market for home computers is comparable to that for video recorders, explains Baxter. Price is often a determining factor. "About 10 years ago, when video machines cost between £1,500 and £2,000, the only people who bought them were businessmen and industrialists. As video recorders became cheaper, a few more people began to buy them, but when the price hit about £500 the market really took off.

"There is a certain price-break on most new, high-technology products, which is linked to demand. As soon as the price reaches that break-point, the product is transformed from a specialist article to a general consumer good. The same thing will apply to computers.

'Digital recording means more accurate loading'

"Sinclair has proved that if you can produce a product at a certain price, the market is there", says Baxter. "I understand from Sinclair that he tried his microcomputer at various prices and it didn't sell, but when he reached about £70-£79 the market took off".

The Sinclair ZX-81 is an excellent way of entering the computing market", says Baxter. "But people quickly tire of its limitations. Research carried out by Commodore indicated that 73 percent of Sinclair owners had exhausted the possibilities of their machines and were looking for something else", he claims.

"We believe they are looking for colour, sound, high-resolution graphics and a proper keyboard. They are looking for a unit which can be truly expanded, with floppy-disc drives and proper printers, so they can do elementary word processing and simple business applications. I don't claim the Vic-20 is a business micro because it is not, but it is capable of being expanded into a sophisticated machine".

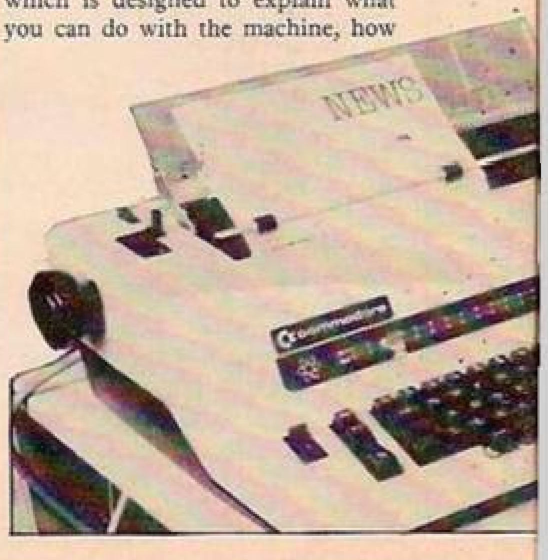
Commodore is currently involved with a TV company which is making a programme about the use of microcomputers in the home. The TV company selected 12 families at random and gave each of them a Vic-20. The programme, which will be shown nationally, is charting their progress.

"The interesting thing is that they have only had the computers for two weeks, but already eight of those 12 families have asked us if they can buy the Vic-20s from us.

"I really do believe that microcomputers will be the boom consumer electronics consumer good of the eighties. I can see, certainly by the end of the eighties, that virtually every home will have a microcomputer. I don't think that is being optimistic, I think it is almost certain to happen".

One of the problems faced by first-time users is that microcomputer manuals are often inaccurate and badly written. This is not a deterrent for the experienced programmer, but it can be very offputting for the beginner, acknowledges Baxter.

"We have produced a manual for the Vic-20 which is aimed at the first-time user. The manual adopts a simple, show-and-tell approach, which is designed to explain what you can do with the machine, how



COMMODORE'S WARES

you can generate colours, sounds and, pictures. If anything, we have been criticised for making the manual too simple.

"I won't deny there are some minor errors in the manual, but we are correcting them. We had 10 to 15 people, who never used a computer before, go through the manual with us and point out the problems.

"One of the obvious difficulties is that a computer needs to know the difference between 0 and O and between 1 and I. This has to be explained because many people who see a program that says line 10 often use the O instead of the 0. Another problem is that some people don't know that upper and lower case refers to capital and non-capital letters".

'By the end of the 1980s, every home will have a micro'

Yet the Vic-20 manual is not designed to teach first-time users how to program. Instead, Commodore U.K. has produced a training package *An Introduction to Basic: Part 1*. The package consists of a 152-page book, two cassettes containing 17 programs and a stencil for writing flowcharts. The complete package costs £14.95.

The training package is intended not only to teach people how to program, but also to teach them good programming techniques, says Baxter. "Although it's wrong, many people write programs straight on to the screen and correct their mistakes as they go along. That is not the way to write a computer program.

"*An Introduction to Basic: Part 1* explains how to write a good program. It talks about subroutine specifications, parameters, input/output and flowcharting".

Commodore has sold more than 30,000 of the training packages, both in the U.K. and abroad. John Baxter is proud of the fact that no errors have been reported, so far: "In all we had about 10 people checking, both for literals and programming errors, and we haven't found one mistake yet. There is bound to be one somewhere, but we actually typed in every single program once the proofs were done, so there are certainly no major errors".

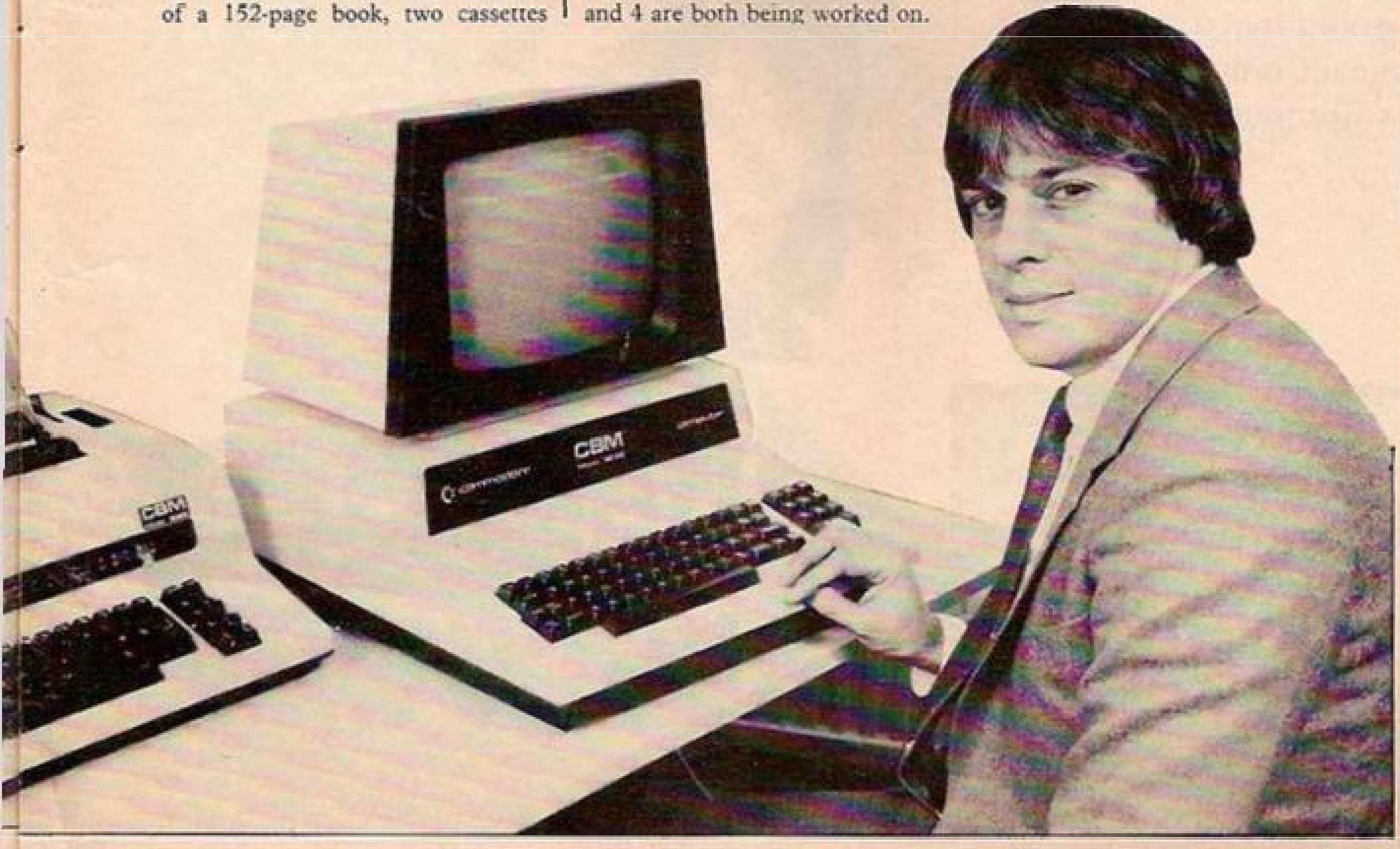
An Introduction to Basic: Part 1, which was written for Commodore by Professor Andrew Colin of Strathclyde University, is being followed by part 2 which will cover advanced Basic and machine-code programming. "Part 2 is just being finalised", says Baxter," and parts 3 and 4 are both being worked on.

"We expect to sell a large amount of Part 1, a significant amount of Part 2 and a much lower amount of Part 4. We don't really expect to sell much of Part 4, but we want to give people the opportunity to progress from being absolute novices to being able to write the most complicated machine code programs".

'People quickly tire of the ZX-81's limitations'

Commodore is also encouraging people to buy its own cassette recorder for saving and loading programs. "The trouble with using audio machines is that they vary a good deal", says Baxter. "If you are playing a music tape and the head is slightly out of alignment it won't make much difference; but if you are trying to load a computer program it will have disastrous consequences.

"You will still be able to write and save your own programs on a recorder with a badly-positioned head, because the recorder will recognise its own wavelength, explains Baxter. But that recorder won't pick up a pre-recorded program with a normal wavelength. This can cause confusion.



"People will say there is something wrong with our cassette and send it back. We will check it and tell them there is nothing wrong with it, and suggest that perhaps there is something wrong with their recorder.

"Our own cassette recorder is specially geared to the Vic-20 and should enable people to avoid most of these problems. In addition, we are giving away a cassette which contains six different programs with each recorder".

In a bid to minimise saving and loading problems, Commodore is using an innovatory method of recording its programs. "In the past, virtually everyone used audio recording equipment to record computer programs", says Baxter. "But we are using a digital recording technique which is far more accurate.

John Baxter acknowledges that this digital recording technique also boosts the chances of users successfully loading Commodore cassette programs using their own recorders. But he warns that digital recording on its own will not solve all saving and loading problems: "There are thousands of different cassette recorders and there is bound to be something funny about some of them which don't like the computer programs".

A few Commodore dealers, such as Stack Computers of Liverpool, supply interfaces to enable Vic-20 users to connect their own recorders into their computers, reveals Baxter. "We have no objections to people doing that kind of thing, but if they do get into difficulties they must realise that it's no longer our problem".

Vic-20 software is just starting to take off, says Baxter. "It is only when computers get into people's homes that the software starts to flood in, and we only started shipping Vics in quantity in December. The software is coming in fast now, but it is always difficult to decide which ones to back. We do encourage other people to market as much software as they can.

"We have five ROM games cartridges of our own which are out now and another 12 which are due to be launched over the next few weeks. Of those, the one that I think will become the biggest seller is the Adventure series which we have had done in conjunction with Scott Adams in the States". ■

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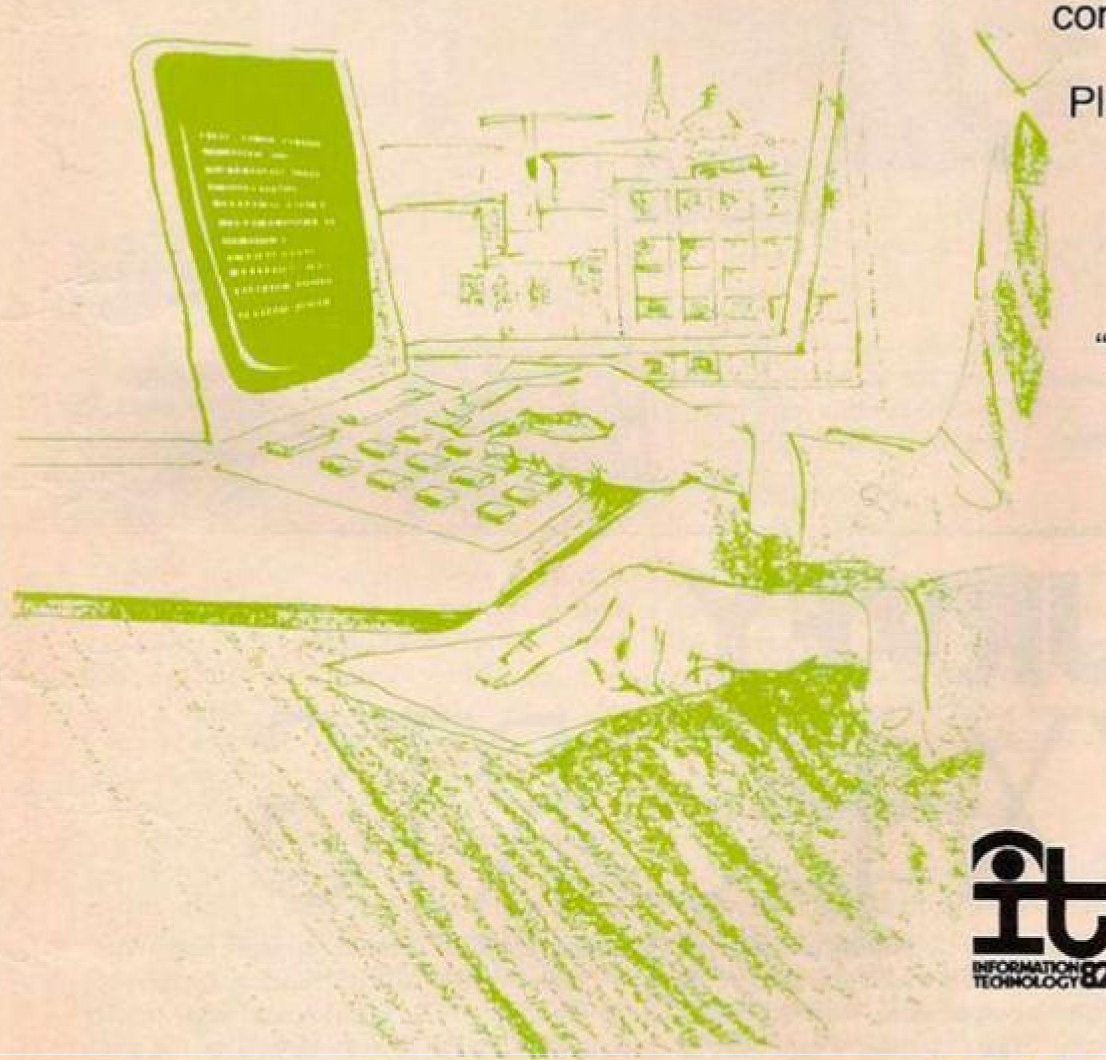
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INFORMATION TECHNOLOGY 82

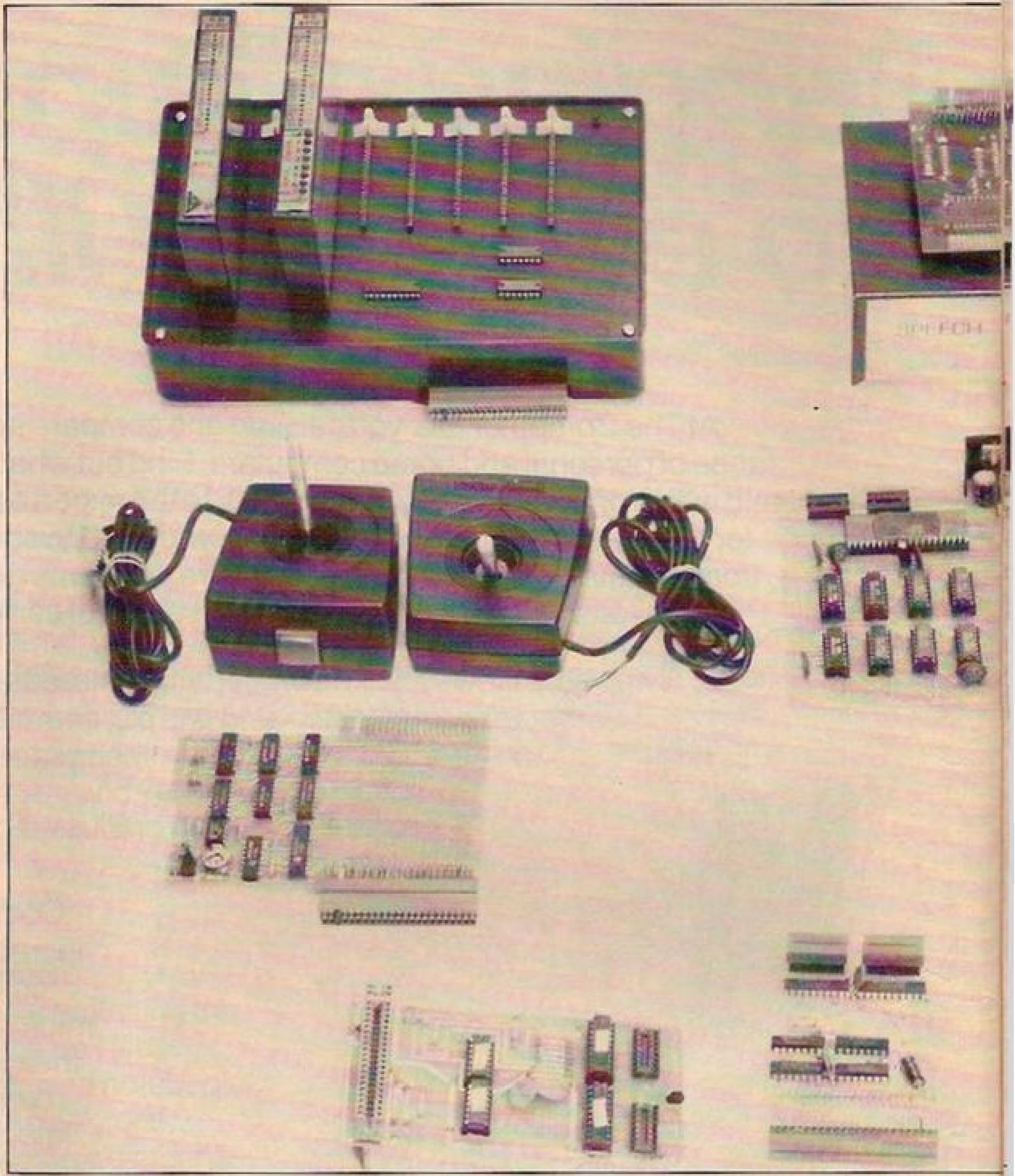
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THE Computer Fair

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To expand your micro to control joysticks, speech input, an 80-column printer or even floppy discs, you will need an additional piece of hardware called a port. Stephen Adams conducts this survey into ports available for the Sinclair machines.



SURVEY ZX PORTS

A PORT IS the gateway through which information enters and leaves a computer; a good example is the cassette port. The information is stored within the computer in eight bits, which form a byte. The maximum amount of bits that can be taken in and out of a port is also a byte.

Each bit on a port is represented by one wire, which will either have +5V, which equals binary 1, or 0V, which equals binary 0. Thus by putting a number between 255 and 0 into the port we can change the conditions on the eight wires. Of course, on an input port the external conditions will cause the eight input wires to be either +5V or 0V. Each port can control, say, relays or printers by operating them from the output port and checking the condition returned by the equipment connected to the input port.

Address locations

The first facts to look for in the literature which accompanies the port are the addresses. These show how the port should be set before trying to input or output any information. There are two places where an address for a port can be located: in memory, like a RAM loction. This is called memory mapping. The second place is a special input/output map which the RAM cannot use. On memory-mapped ports the data can be Peeked and Poked just like a piece of RAM, using the Sinclair Basic command. To enter data through the port, you would use the Input command:

```
10 LET PORT = PEEK LOCATION
```

Equally, to output data:

```
20 POKE LOCATION, NUMBER.
```

Table 1 shows the various ports tested and the memory locations in either the input/output map or the memory map.

When the ports are not memory-mapped, one needs to write a small piece of machine code to replace the Peek and Poke commands of Basic. Peek and Poke can be stored in one of two places: high memory, above the RAMtop variable, or in a Rem statement, at the beginning of the program. Two manufacturers offered only one of these locations; William Stuart and JMJ.

Machine-code programs have been written by all the manufacturers for accessing their ports, but only one, Thurnall, expected you to write your own after being told how to address the port. The others gave an address in which to Poke and output, and offered a USR address for moving data in and out of the port. USR returns with a value in register BC which is used to return the input value of the port given. For example,

```
LET A = USR X
```

leaves the value of BC in A.

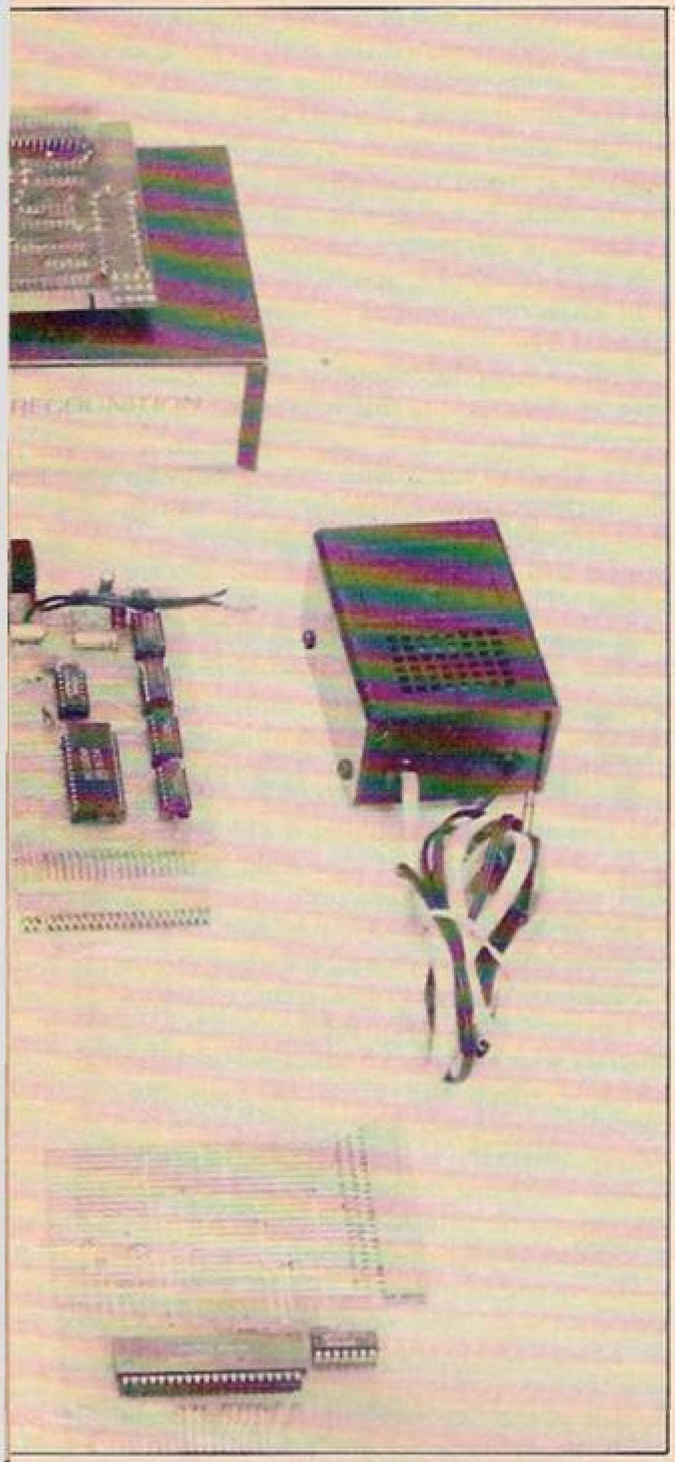
Where a control port is used, it must first be set up. You do this by outputting a number to the control port to tell it which port is to be for input and which output. Also, with Quicksilva and William Stuart ports, which use a combined input/output and music-generation chip AY-8910, the control register must be told which port to look at, since only one of the two ports can be input or output at one time.

The way ports are addressed can also give rise to problems since Sinclair-designed equipment is sometimes inaccurate. Some of the memory-map addresses are decoded by only one or two address lines instead of the complete 16 available. This leads to a reduction in the number of chips required for each unit, but leaves the device to appear a number of times in the memory or input/output map; it should appear only once.

Three devices failed a functional test with the Sinclair 16K RAM pack and printer connected to the system as well as the port. William Stuart clashed with the printer which only uses A2 to activate itself. JMJ clashed with the keyboard, which uses A0, and the slow mode, which uses only A0 and A1.

Potential problem

On the ZX-80, however, the Technomatic's port works at location 25000 thus leaving only 7K of memory space for RAM. If, therefore, you have a 16K RAM on a ZX-80 with 8K or 4K ROM, this port can cause problems. It is advisable to ask yourself, if you buy extra memory or ports, whether they will clash.



Manufacturer	Read Write	Address variation	Input/Output	Memory map
Ground Control A	49155	0		✓
B	49152	0		✓
C	49152	0		✓
Control	49154	0		✓
16K RAM	16384-32767	0		✓
Bolton Electronics	65535-65532 selection strap	0		✓
Technomatic	11000	256		✓
Thurnall				
A	111	0	✓	
B	127	0	✓	
C	79	0	✓	
D	95	0	✓	
William Stuart Systems				
Control	195-219	0	✓	
Data	199-233 by straps	0	✓	
Micro Gen	15376-16384	1K		✓
DCP				
Port	21504-22272	1K		✓
RAM	16384-21248	0		✓
Quicksilva Control	32767	0		✓
Data	32766	0		✓
RD Laboratories System 8100	15360-15567 selection by straps 14 addresses per module	0		✓
JMJ				
Control A	2	Unknown	✓	
Data A	0	as unit	✓	
Control B	3	sealed	✓	
Data B	1		✓	

Note: Some of the port addresses given for the ZX-81 cannot be used on the ZX-80. Alternative addresses are: Bolton, −1 to −4; RD-8100, 31744 to 31951; Technomatic, 25000; Ground Control, −16384 to −16381.

Table 1.

Power supplies can also cause problems, since all these extras are mostly driven from the ZX-81 9V or 5V supplies. Table 2 shows the extra current required by the ports. Two ports were supplied with sockets for alternative power supplies. Their ground controls must have a second power supply otherwise the RAM on board will not work.

Another potential problem is the number of boards connected directly to the ZX-81 expansion port. The ZX-81 may not be able to supply any of the boards because the load is too great. The only board to solve this and the power supply problem is RD Laboratories 8100 system which is fully buffered on the Address and Data lines. JMJ and DCP solve this problem by blocking off the expansion port on the ZX-81 so that only the printer can be used.

All of the units functioned well, apart from the clashes mentioned. The few that are available as kits should cause no problems to construct. The instructions are, however, somewhat scant, and so you should have some experience of building with integrated circuits.

There is, however, one word of warning: the output of all of the ports is only +5V maximum which is only enough to supply current to drive one logic chip in most cases. So, to control relays or mains voltages from the output port, extra equipment must be used to cope with higher voltages and current. Any voltage higher than +5V or lower than −0V will damage the port if applied to its input.

Concrete examples

Most of the documentation tells you what marvellous applications are possible, but few actually give concrete examples. Technomatic's must be one of the better examples — with the port are 14 pages of circuit diagrams describing things to do with the input and output. Some manufacturers do more and supply you with extra equipment which will plug into the port to allow it to control higher voltage, via relays or measure voltages via an analogue-to-digital converter.

The award for the best application must go to Micro Gen which supplies its port for only one purpose — to control two joysticks, so you can program their use.

Most ports have the same amount of data available on input and output, so that external equipment can be modified to fit the board and only the program has to be changed to use it. One application project which will fit any port is the speech-input device called Big Ears from William Stuart Systems. It requires only the use of bit 7 and bit 6 of an input port. Other interfaces can be designed to run a proper 80-column printer, a Modem — although the software will have to cope with the parallel-to-serial conversion — and even a floppy-disc system.

Among the units available is the analogue-to-digital and digital-to-analogue converter from DCP, called an A pack. It converts a voltage from 0V to 2.5V into a byte-sized number on the input port. The digital-to-analogue converter does the opposite, but the current supplied is not great; accuracy is ±5 percent.

The DCP relay output pack can switch up to 12V 1A. Called a C pack, it also has the inputs held to binary 0, which is opposite to normal.

The RD Laboratories RD-8110 is a logic input and output port with light-emitting diodes for quick identification of the output state. The RD-8130 is an eight-bit analogue-to-digital converter whose comparison voltage can be varied by links. The RD-8180 is a light-pen system for drawing on the screen.

The Bolton Electronics port is a good design

(continued on next page)

(continued from previous page)
as it stops the RAM-pack wobble by laying the 16K on the table and raising the ZX-81 45° upwards. There is provision for four more boards on the same system through the use of different straps. However, it will not work with any RAM greater than 15K. It costs £15.90 built or £12.90 as a kit plus £1 postage and packing.

The port from DCP Micro Developments is a good system for schools with 4K of RAM included in the basic P pack and the single port. It is sufficiently tough, supplied in its own black box, and the Molex pins are well spaced, and so will not be easily broken. The A and C packs can make it more versatile, but only one can be connected at a time.

The problem with this system is that it is hard to expand, it will not work with the 16K RAM pack and other packs cannot be connected to the ZX-81 because the P blocks the way. The output of the C and A packs is via 2mm. Wander sockets. The cost of the basic P port is £37.95 and the A pack, £19.95; the C pack costs £29.95. Both C and A packs must be used with a P pack.

The Ground Control port has 16K of RAM and a three-port input/output device on one board. The port is a 8255 PI/O and the data sheet will only be supplied in return for a stamped, addressed envelope. The output is via two 14-pin integrated-circuit sockets, and the edge connector for the ZX-81 is supplied at a cost of £3.20 extra. It also requires a separate 200mA 12V power supply to be connected to the board which can be supplied at an extra cost of £6.

The black blobs

This board must be mounted in a case — it is hazardous to use it without one. You will have to put up with black blobs occasionally on the screen at switch-on because of the power supply. The cost of the board is £47 for the ready-built version and £42 for the kit.

The JMJ Interfaces ZX-81 User Port Module is enclosed in a black blob of epoxy resin. This Z-80A PI/O module is supplied with a book of interface instructions for the control of relays and the sensing of light and heat. All the connections to the PI/O are available on a 24-pin integrated-circuit socket moulded into the case.

It has no extension connector and so it blocks off any other use for a 1K machine, including the 16K RAM pack. It also clashes with the keyboard port and slow mode on the ZX-81. The cost is £29.

The Micro Gen joystick port has two analogue-to-digital converters which can connect to two converted Tandy joysticks for use in games. The use of it in a Basic program is so simple. In a machine-code program you must wait 0.5ms. for it to obtain its result.

Each joystick is calibrated in two directions between 27 and 14, although this can be adjusted to your requirements. The cost of the controller port is £19.80, and the joystick £9.60. Software includes Space Invaders and a ZX Maze at £6.95.

The Quicksilva sound and input/output board fits to the ZX-81 via a £12 motherboard. Alternatively, it can be fitted via a double-sided edge connector called a QS connector because it consists of just a printed-circuit board with a fingered edge like the ZX-81. Access to the port is rather difficult, due to the use of a AY-8910 integrated circuit which has 16 registers of which the input and output registers form only a part.

Manufacturer	Current from ZX-81 power supply	Power from other source
Bolton	60mA.	
DCP P pack	45mA.	
A pack	60mA.	
C pack maximum	77mA.	
Ground Control	20mA.	250mA.
JMJ	70mA.	
Micro Gen	70mA.	
QS Sound Board	170mA.	
RS Super-Mum	80mA.	
8110	80mA.	
8130	40mA.	
Technomatic	40mA.	
Thurnall	30mA.	
William Stuart	100mA.	
Sinclair 16K RAM	260mA.	
Printer	500mA.	

Note: The Sinclair power pack will provide only 700mA and the printer power pack will only supply 1.2 A.

Table 2.

Therefore, to change from one register to another you must Poke the register number required into the control port, and then Peek or Poke the data into the port you want. As the music registers also use these locations, the programming can become somewhat complicated.

The sound/input/output board costs £26 and you should state for which machine you are ordering it. This is one of many boards available from Quicksilva which includes high-resolution graphics, programmable CHR$ generator and 3K RAM. The board will, however, clash if you decide to buy more than 16K of memory for your system.

The RD Laboratories RD-8100 system module that we tested was the Super-Mum complete with the RD-8110 input/output port, and the RD-8130 analogue-to-digital input. The Super-Mum is buffered which means that any of the modules can be disconnected at any time without crashing the ZX-81. However, RD Laboratories offers a Micro-Mum which is not buffered and which can take only two modules; the Super-Mum can take eight.

Unit selection

The units are sealed and can be selected by two of 14 addresses, which means more than one type of board can be plugged in. It has two disadvantages, however; one that the top of the unit flexes when modules are plugged in; the second is that the pins at the top are very easily bent out of line.

Apart from this, it will be very useful for those people who require a large system, for monitoring equipment because plenty of modules can be added and no special connectors are required. The Super-Mum motherboard costs £40; Micro-Mum, £15; RS-8110, £22.50; RD-8130, £29.50; plus 80p per order to cover the cost of postage and packing.

The £14.95 Technomatic port is a single-card which fits vertically behind the ZX-81. It has not only separate read and write sockets, but also access to the +5V and 0V power supplies. It works reasonably well except on the ZX-80. If, however, a fault develops, only Technomatic can replace the chips as they are only numbered 1 to 4. Special documentation, at £1 extra, contains some very useful designs for circuitry.

We found that the connections to the ZX-81 were too short and the 16K RAM pack did not seem to fit well.

The Thurnall Electronics port is mainly for the machine-code programmer. The instructions reveal that it can be programmed only in hexadecimal and refer you to the Sinclair manual. This input/output mapped port is fully-decoded and so will not be affected by Sinclair add-ons. Documentation gives some good examples of how to control higher voltages, but not what to do with the port itself. A 23-way edge connector is also required to access the output and input bits. The cost of the Thurnall port is £12.99 built, or £10.99 as a kit, to which should be added VAT and 50p postage and packing.

The William Stuart Systems port is well designed with stereo output, because it is also a sound board, and an AY-8910 chip to control it. Routines were given for a machine-code program which gives commands for using the port and which will make the Basic programmer feel happier. The examples of its use were, however, a trifle basic. It was disappointing that the routines, used to access the port, set the printer running, but this may be avoided by changing address straps.

The sound board costs £25.50 built and £19.50 as a kit plus VAT. We would have liked to try the sound facilities of this board with the tape provided, but it would not load because of the fact that *Surfing U.S.A.* could still be heard in the background.

Suppliers.

Bolton Electronics: 44 Newland Drive, Bolton, Lancashire. Telephone: 0204-64772.

DCP Micro Developments: 2 Station Close, Lingwood, Norwich NR13 4AX. Telephone: 0603-712482.

Ground Control: Alfreda Avenue, Hullbridge, Essex SS5 6LT. Telephone: 0702-230324.

JMJ Interfaces: Old School House, Rettendon Turnpike, Battlesbridge, Wickford, Essex.

Micro Gen: 24 Agar Crescent. Bracknell, Berkshire. Telephone: 0344-27317.

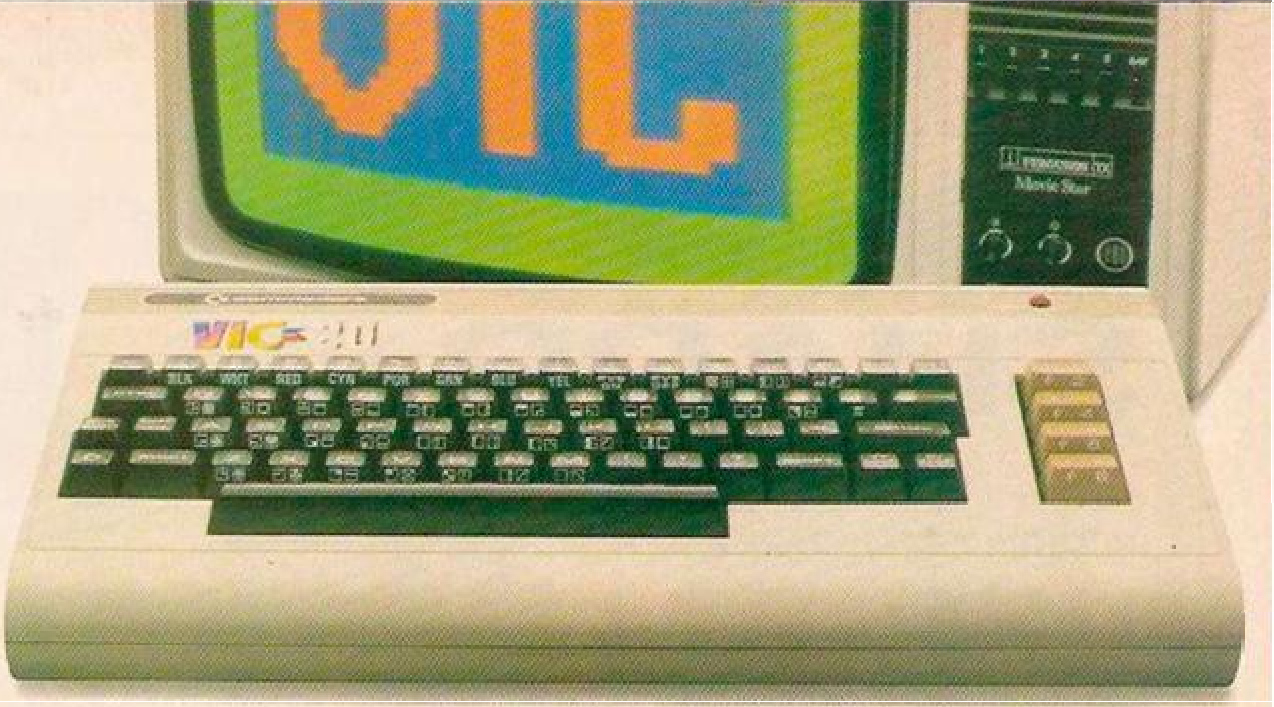
Quicksilva: 95 Upper Brownhill Road, Maybush, Southampton, Hampshire.

RD Laboratories: 5 Kennedy Road, Dane End, Ware, Hertfordshire SG12 0LU. Telephone: 0902-84380.

Technomatic: 15 Burnley Road, London NW10. Telephone: 01-452 1500/450-6597. Telex: 922800.

Thurnall Electronics: 95 Liverpool Road, Cadishead, Manchester M30 5BG. Telephone: 061-775 4461.

William Stuart Systems: Dower House, Herongate, Brentwood, Essex CM13 3SD. Telephone: 0277-810244. ■



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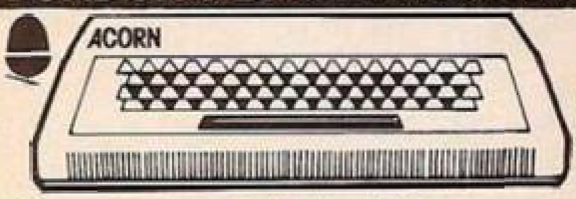
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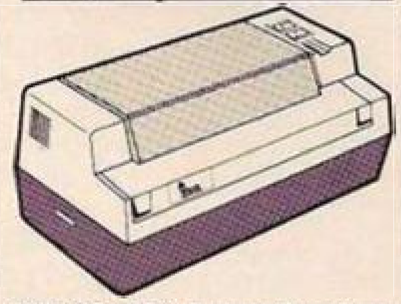
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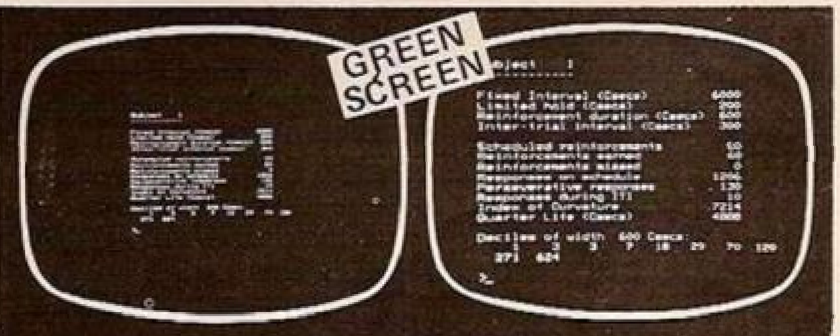
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THREE SORTS OF SPEED FOR THE ZX-81

David Lawrence has prepared a trio of sorts for use on the ZX-81. Under test conditions the shell-Metzner, the fastest of the three, outstripped the commonly-used bubble sort by more than 21 minutes.

GIVEN THE CHOICE, how long would you prefer your micro to take over a given task? The question is not as stupid as it sounds, especially when dealing with the ZX-81, which not even its best friends would describe as fast.

While machine-code buffs may worry whether a different method of executing a job might save a few microseconds, ZX-81 owners tend to be more concerned whether a complex program will finish its run before they go to bed. You do not have to be trying to calculate pi to a million decimal places to run into that problem. In the January issue in Software File a program entitled "Effortless Index" by L Basford appeared. The object of the program was to sort data such as names into alphabetical order for subsequent use.

The program worked perfectly and used a sorting method known as the bubble sort. "Bubble" because of the way in which items of data bubble up and down the array in small steps until they reach their correct place. However, run in slow mode, it took 24 minutes and 25 seconds to sort 100 randomly chosen words. Such times are not untypical of many sorting programs published by or for micro owners. Yet for little or no extra effort a successful sort can be achieved which is many times faster.

In this program, written for a 16K ZX-81, three of the many hundreds of sorting methods are tested against each other using a list of 100 random words generated within the program. All the methods would work equally well with numbers rather than with strings.

The program is designed to illustrate why it is that different sorting methods can vary so much in the amount of time they take. It does this by displaying two important pieces of information which are essential in assessing any sort, namely:

- The number of times the program compares items within the list to be sorted, in order to rank them in value.
- The number of times items are exchanged within the list until the correct order is achieved.

If you wish to time the sorts, you will have to do it with a stop-watch. If you do not wish to try the whole program, then any of the three self-contained subroutines can be lifted straight out of the program, deleting only the lines which set and increment S and C, which are the counters for swaps and comparisons.

The first of the three sorts is an exchange

(continued on next page)

```
SORTING ON THE ZX-81
1 GOTO5
2 SAVE "SORT"
3 STOP
1000 REM ***********************
1010 REM RANDOM WORDS
1020 REM ***********************
1030 DIM A$(100,15)
1040 DIM B$(100,15)
1050 FOR I=1 TO 100
1060 LET L=INT(RND*10+2)
1070 LET T$=""
1080 FOR J=1 TO L
1090 LET T$=T$+CHR$(INT(RND*26+38))
1100 NEXT J
1110 LET A$(I)=T$
1120 SCROLL
1130 PRINT A$(I)
1140 NEXT I
1150 REM ***********************
1160 REM GOSUBS FOR SORTS
1170 REM ***********************
1180 GOSUB 2200
1190 GOSUB 1250
1200 GOSUB 2200
1210 GOSUB 1500
1220 GOSUB 2200
1230 GOSUB 1760
1240 STOP
1250 REM ***********************
1260 REM EXCHANGE SORT
1270 REM ***********************
1280 PRINT "EXCHANGE SORT"
1290 LET N=100
1300 LET A=0
1310 LET B=0
1320 LET C=0
1330 LET S=0
1350 LET A=A+1
1360 IF A=N THEN GOTO 1480
1370 LET B=A+1
1380 LET C=C+1
1390 IF B$(A)>B$(B) THEN GOTO 1430
1400 LET B=B+1
1410 IF B>N THEN GOTO 1350
1420 GOTO 1380
1430 LET S=S+1
1440 LET T$=B$(A)
1450 LET B$(A)=B$(B)
1460 LET B$(B)=T$
1470 GOTO 1400
1480 GOSUB 2080
1490 RETURN
1500 REM ***********************
1510 REM DELAYED REPLACEMENT
1520 REM ***********************
1530 PRINT "DELAYED REPLACEMENT SORT"
1540 LET A=0
1550 LET B=0
1560 LET C=0
1570 LET D=0
1580 LET N=100
1590 LET S=0
1600 LET D=D+1
1610 IF D=N THEN GOTO 1740
```

(listing continued on next page)

(continued from previous page)

sort. It begins by looking at the first item and comparing it with the second. If item 1 is less than item 2, then they are swapped. All explanations are on the understanding that the list is to be sorted into ascending order, starting with position 1 — that is, A,B,C,D,E.

Item 1 is now compared with item 3 and the two are swapped if 3 is less than 1. 1 is now compared with 4, and so on. By the time item one has been compared with every other item in the list, and any necessary swaps made, the smallest item must be in position one. The procedure is now repeated for position two, and so on down the list.

Comparing this method with the bubble sort mentioned earlier, we find that the number of comparisons required is reduced from 9,173 to 4,950 and the number of swaps remains constant at 2,403. This results in a reduction in the amount of time taken to sort the same list from more than 24 minutes to 13.5 minutes.

Even though a considerable amount of time is saved, much unnecessary swapping is still occurring. Each time the program finds an item smaller than, for instance, item 1, the two are swapped. While this does finally result in the smallest item being in the correct position, it is only at the expense of putting many items which are not the smallest there first.

If the original order of items were E,D,C,B,A then every item in the list would have been in position 1 before the correct one is settled on. Clearly, we could increase the efficiency of the sort if the program first found the lowest value item and only then made the swap.

Comparison table. Alphabetical sort of 100 words by differing methods.

Method	Swaps	Comparisons	Time in minutes
Bubble	2,403	9,173	24.25
Exchange	2,403	4,950	13.15
Delayed-replacement	95	4,950	9.02
Shell-Metzner	379	801	3.01

Figures are for one particular list and would vary for other lists.

This is achieved by the second sort, the delayed-replacement sort, which requires 16 program lines rather than 14 for the first method and, in return for the extra lines, reduces the sort time to nine minutes, with 4,950 comparisons as in the previous method, but only 95 swaps — five items happened to be in the correct position originally.

Process of improvement

The process of improvement could go on indefinitely. There are many hundreds of different methods of sorting, some of them general, some designed for very specific purposes. Many of them are more or less radical variations of the basic methods already discussed but real speed requires a different approach. One such approach is exemplified by the third method given in the test program, generally known as the shell-Metzner sort.

The detailed working of this sort is too complex to go into here. Suffice it to say that rather than searching methodically for the lowest value, the program scans the table of items, comparing pairs with a gap between them of

((2**I)−1)/2

where 2**I is the smallest power of 2 which is greater than the total number of items in the list. This is followed by a scan of pairs having half that gap, and so on.

This invariably results in a higher number of swaps than method two but combined with dramatically fewer comparisons. The routine given for this method in the test program requires 21 lines — six more than the previous method. However, it reduces the time taken to complete the sort to three minutes — one-eighth of the time taken by the bubble sort — with 801 comparisons and 379 swaps.

Whether or not such an increase in speed justifies the extra program space depends on how often and how many items you want to sort. The saving in time will increase proportionately as the number of items increases. However, every micro owner needs to be aware that a variety of sophisticated sorts such as the shell-Metzner are easily available to increase the power of their machines.

The test program runs in slow mode; in practice, the sort section of any program should be run in fast, cutting execution time by 50 percent.

(listing continued from previous page)

```
1620 LET A=D
1630 LET B=A+1
1640 LET C=C+1
1650 IF B$(B)<B$(A) THEN LET A=B
1660 LET B=B+1
1670 IF B<=N THEN GOTO 1640
1680 IF D=A THEN GOTO 1600
1690 LET S=S+1
1700 LET T$=B$(A)
1710 LET B$(A)=B$(D)
1720 LET B$(D)=T$
1730 GOTO 1600
1740 GOSUB 2080
1750 RETURN
1760 REM ********************
1770 REM SHELL-METZNER
1780 REM ********************
1790 PRINT "SHELL-METZNER SORT"
1800 LET C=0
1810 LET S=0
1820 LET A=1
1830 LET N=100
1840 IF 2**A>N THEN GOTO 1870
1850 LET A=A+1
1860 GOTO 1840
1870 LET F=2**A-1
1880 LET F=INT(F/2)
1890 IF F=0 THEN GOTO 2060
1900 LET D=N-F
1910 LET B=1
1920 LET A=B
1930 LET E=A+F
1940 LET C=C+1
1950 IF B$(A)>B$(E) THEN GOTO 1990
1960 LET B=B+1
1970 IF B>D THEN GOTO 1880
1980 GOTO 1920
1990 LET S=S+1
2000 LET T$=B$(A)
2010 LET B$(A)=B$(E)
2020 LET B$(E)=TS
2030 LET A=A-F
2040 IF A<1 THEN GOTO 1960
2050 GOTO 1930
2060 GOSUB 2080
2070 RETURN
2080 REM **********************
2090 REM PRINT SORTED LIST
2100 REM **********************
2110 FOR I=1 TO 100
2120 SCROLL
2130 PRINT B$(I)
2140 NEXT I
2150 SCROLL
2160 PRINT "COMPARISONS:";C
2170 SCROLL
2180 PRINT "SWAPS:";S
2190 RETURN
2200 REM **********************
2210 REM RESET LIST
2220 REM **********************
2230 FOR I=1 TO 100
2240 LET B$(I)=A$(I)
2250 NEXT I
2260 CLS
2270 RETURN
```

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BASIC

TRANSLATING SOFTWARE

Good form seems to demand that every new micro should have its own idiosyncratic Basic dialect. So, where the newcomer might expect to find a wealth of software, incompatibility reigns supreme. Tony Edwards starts his new series on software translation with a look at the broad techniques.

YOUR FIRST consideration must be whether translation is worth the effort. This depends on the complexity of the task and on how badly you want to run the program in question. It is often difficult to assess just how complex the task of translation will be, but here are some general points for guidance.

First, judge the size of the program by its number of lines and the amount of memory it is said to use. Look at the program's Basic dialect to see if it is familiar or completely alien. Compare the computer the program was written for with yours. If the program is an Adventure written for a 1MB mainframe, you cannot reasonably expect it to run.

Even if the prospects for direct translation are poor, the idea may be transportable if you think it worth the effort. This would entail reducing the program into a flowchart, and the conversion of the flowchart into your dialect of Basic. This is a long task, but one that is sometimes worth the effort.

Unportable graphics

Another factor in evaluating the complexity of translation is the amount of graphics used. Graphics are the most unportable part of Basic dialects and a program which relies largely on graphics may lose most of its impact on translation. You will often have to completely reprogram the graphics, and you must learn by experience which types of computer have superior graphics to yours and thus have graphic programs which are worthless on translation.

In both graphical and non-graphical programming it is always easier to translate up rather than down. For instance, ZX-80/81 programs usually translate well on to a TRS-80 or Pet, but translation in the other direction is difficult and often only ideas can be used.

This is an advantage for non-ZX-80/81 users as many very clever programs and subroutines have been published for ZX-80/81 which can be easily and usefully translated for use on bigger machines.

One final warning. If the program to be translated contains Peek/Poke statements — or their equivalents such as Deek/Doke, Exam/Fill and Fetch/Stuff — leave well alone unless the listing includes details of the reason for these statements and you are confident you can identify equivalent Peek/Poke addresses on your own machine.

Having decided on translating a program, you need a strategy to ensure it is done in a systematic way. Read the whole listing and mark any line which contains any statement you do not recognise as part of your dialect. Then go through, line by line, typing in the program, and each marked line can be altered to suit your dialect.

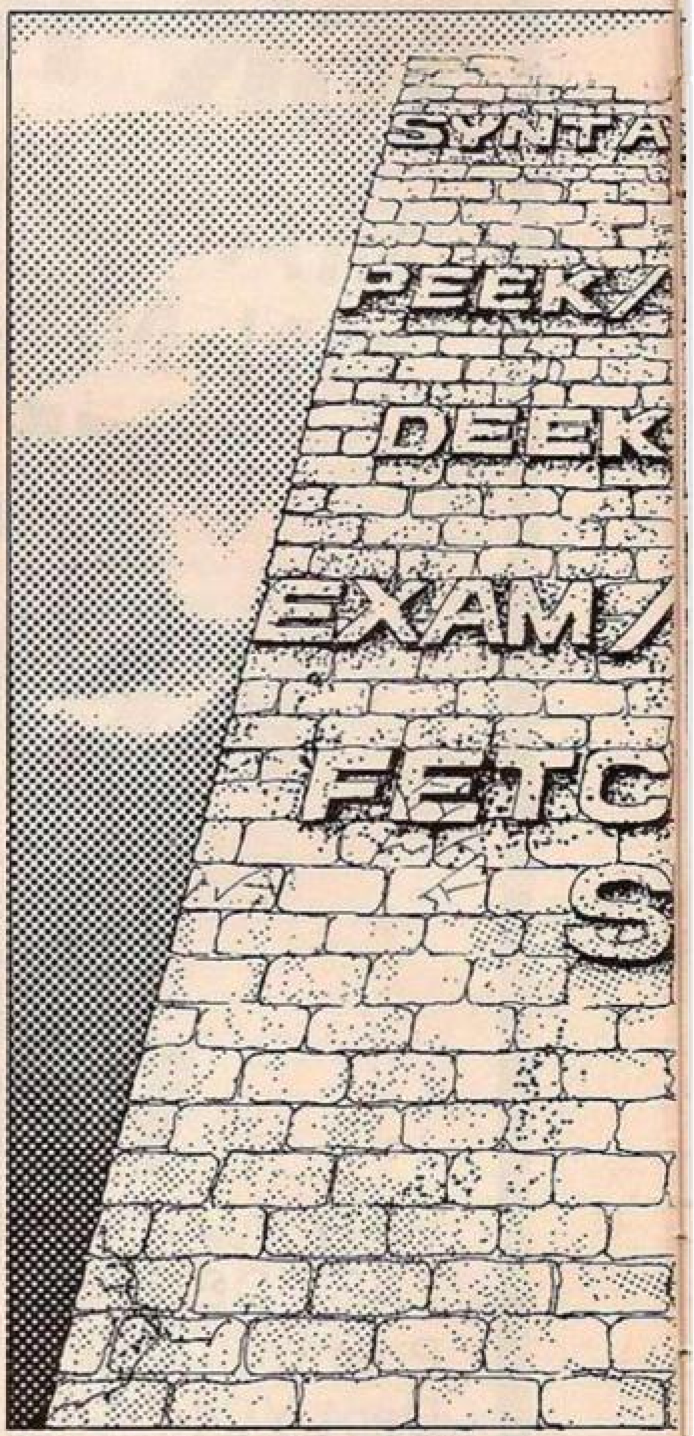
In many cases the necessary alterations are simple and obvious but some will be more difficult — the program may contain statements which you do not understand, or statements which your machine is not able to mimic. In the November issue, Guy Brooker offered a useful little subroutine for drawing a line between two points on the video screen. This program was for the ZX-81 and is reproduced here with the lines containing statements not recognised by my Basic dialect marked with an asterisk.

I have added two lines at the start of the program and changed the last one so it runs as a program rather than as a subroutine. This is good strategy in complex programs as it allows separate sections to be translated and tested individually.

```
 10 PRINT "1ST POINT CO-ORDINATES";
    INPUT X1, Y1
 20 PRINT "2ND POINT CO-ORDINATES";
    INPUT X2, Y2
 30 LET G = 0
 40 LET H = 0
*50 LET X = X2-X1
 60 LET Y = Y2-Y1
*70 LET Z = ABS X
*80 IF ABS Y > Z THEN Z = ABS Y
 90 FOR F = 1 TO Z
*100 PLOT G + X1, H + Y1
 110 LET G = G + X/Z
 120 LET H = H + Y/Z
 130 NEXT F
 140 END
```

My computer accepts assignment statements with or without Let, so I deleted all Let statements and concentrated on the marked lines 70, 80 and 100. My dialect required brackets around the argument of functions, so I added them. With regard to line 100, this simply switches on the indicated graphics block on the ZX-81 so I replaced it with the equivalent from my Basic dialect and produced the translated program:

```
10 PRINT "1ST POINT CO-ORDINATES";
   INPUT X1, Y1
20 PRINT "2ND POINT CO-ORDINATES";
   INPUT X2, Y2
30 G = 0: H = 0: X = X2 - X1: Y = Y2 - Y1
70 Z = ABS (X)
```

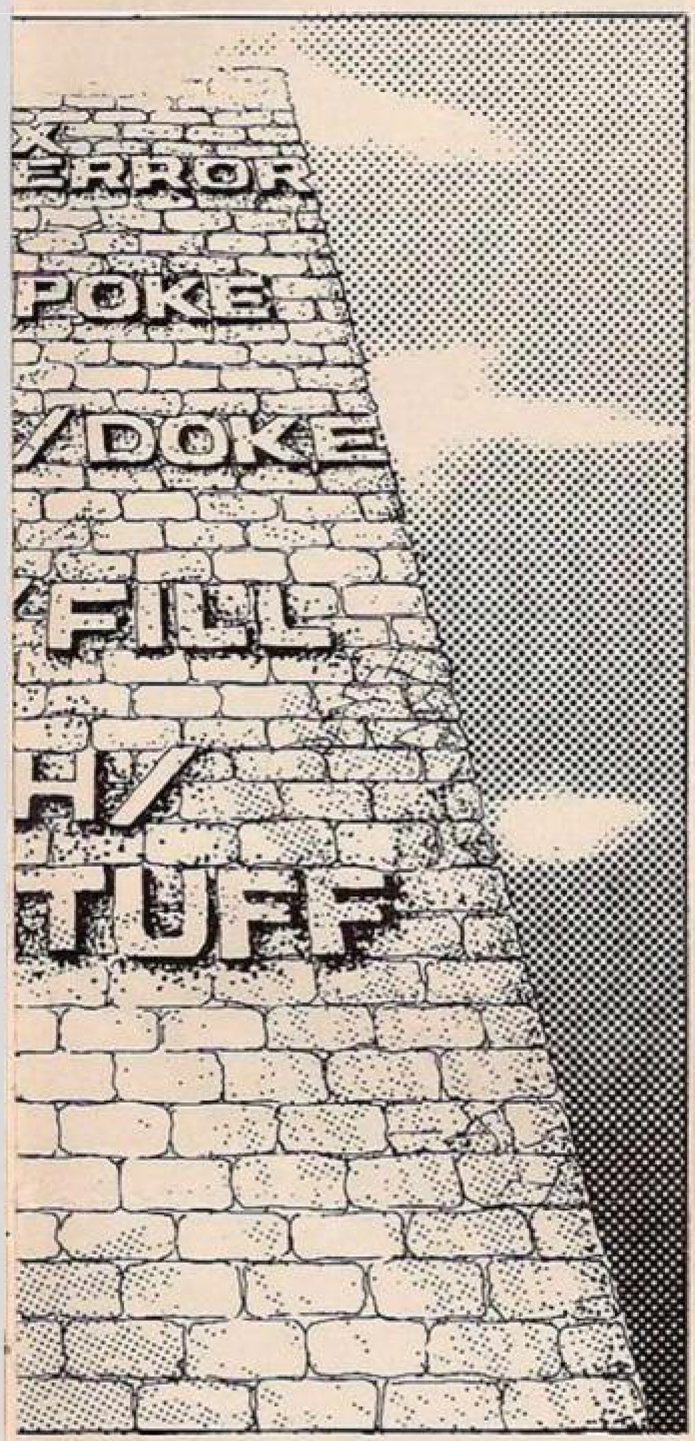



```
 80 IF ABS(Y) > Z THEN Z = ABS(Y)
 90 FOR F = 1 TO Z
100 SET (G + X1, H + Y1)
110 G = G + X/Z: H = H + Y/Z
130 NEXT F
140 END
```

Moment of truth

Now the moment of truth. Type Run and test it. In my case it worked and I have a very useful subroutine for use in future programmes when drawing graphics. Perhaps it did not work for you. If not, further translation is necessary. Two faults could occur: your computer may have returned a syntax-error prompt. If this is the case, it has identified another line which needs translation.

FOR YOUR MACHINE



The other fault is more difficult to handle. Perhaps the translated program ran but produced the wrong results — as it would on a TRS-80 with 32 characters selected. If this was the case when you tried you must look at the logic of the translated program and see why it does what it does rather than what it was intended to do.

A possibility not to be overlooked when faced with this problem is difficulties with integer and non-integer arithmetic — does your machine have the same type as the machine for which the program was written? In this case, the program was written using integer arithmetic, but the Set statement, or its equivalent, has an implicit Int function on most machines so this does not matter.

The Inkey$ or its equivalent, is often used and causes difficulties in translation. Inkey$ is used in TRS-80 level 2 Basic to read a character directly from the keyboard without waiting for the <enter>. It is used in a loop such as

```
10 IF INKEY$ = "X" GOTO 100 ELSE
   GOTO 10
```

or

```
10 A$ = INKEY$: IF A$ = "X" THEN 100
ELSE 10
```

which waits until the X key is pressed then moves on to line 100.

Some machines have similar statements, which you will recognise if you have one. For example, Pet users will recognise this function as similar to that of Get A$. Many machines have no equivalent statement, and short of using a normal Input statement, their owners may be in trouble.

However, let us reflect for a moment. After pressing a key, what happens to the character while the machine waits for additional input or the <enter> command? The answer is that it is stored in the keyboard buffer. So all we have to do is look at the buffer to see if a key has been pressed and we have our Inkey$ statement.

Unfortunately, it is not always as easy said as done. First where is the keyboard buffer? It must be in the RAM somewhere. If you do not know where it is in your machine and the instruction book does not help you, it should not be too difficult to find, as it must lie between the ROM addresses and the first RAM address available for a Basic program. Once the keyboard buffer has been identified a short machine-code program is the best way of producing an Inkey$ statement. If you have a ZX-80 the required program is:

```
10 REM XXXXXX
20 LET A = 16426
30 POKE A, 219
40 POKE A + 1, 0
50 POKE A + 2, 111
60 POKE A + 3, 38
70 POKE A + 4, 0
80 POKE A + 5, 201
```

With this routine at the start of the program; the Inkey$ statement can be mimicked with

```
LETA = USR (16426)
```

but remember to bed it in a loop. Similar routines can be created for other machines. On the UK101, for instance, the equivalent routine would be:

```
10 FOR I = 592 TO 619: READ Z: POKE I,Z:
   NEXT I
20 DATA 173,79,2,240,5,32,231,249,208,4,141,
   19,2,96,32
30 DATA 0,253,169,0,141,79,2,169,1,141,20,
   2,96
```

This program should be loaded, run and Newed. Then the Inkey$ statement could be simulated by:

```
100 POKE 11,80: POKE 12,2: POKE 591,1
110 X = USE(X): Z = PEEK (531):IFZ≠
0 GOTO 1000: GOTO 110
```

If you cannot face machine code, the Inkey$ statement can be mimicked from Basic. At the start of your program, set up a cross of switched-on pixels, as shown in figure 1, in some corner of the display.

When you require the Inkey$ input, use cursor control or Print @ to place the cursor in the centre of the cross. Use of the up-, down-or back-arrows or the space back at this stage will blank one of the four pixels on most machines, so here is our Inkey$ function.

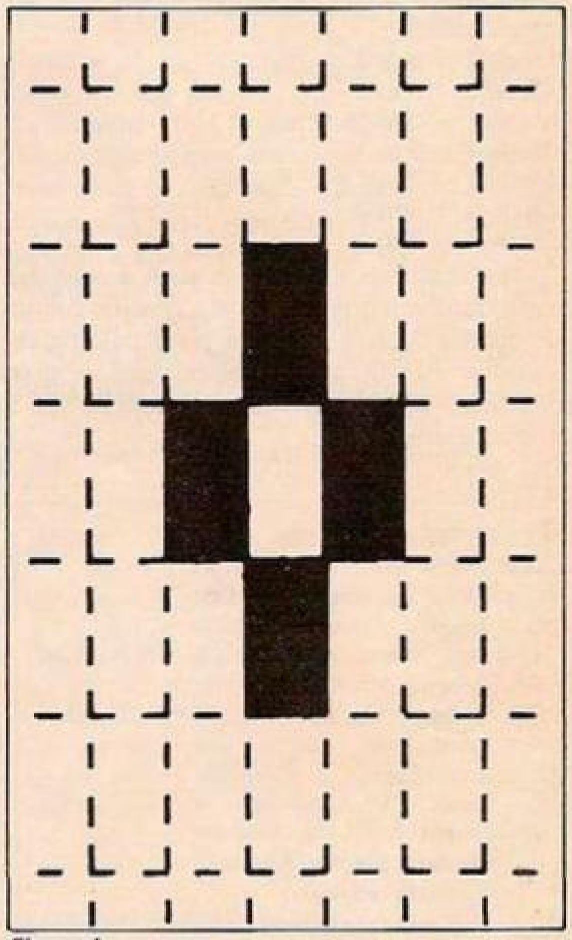


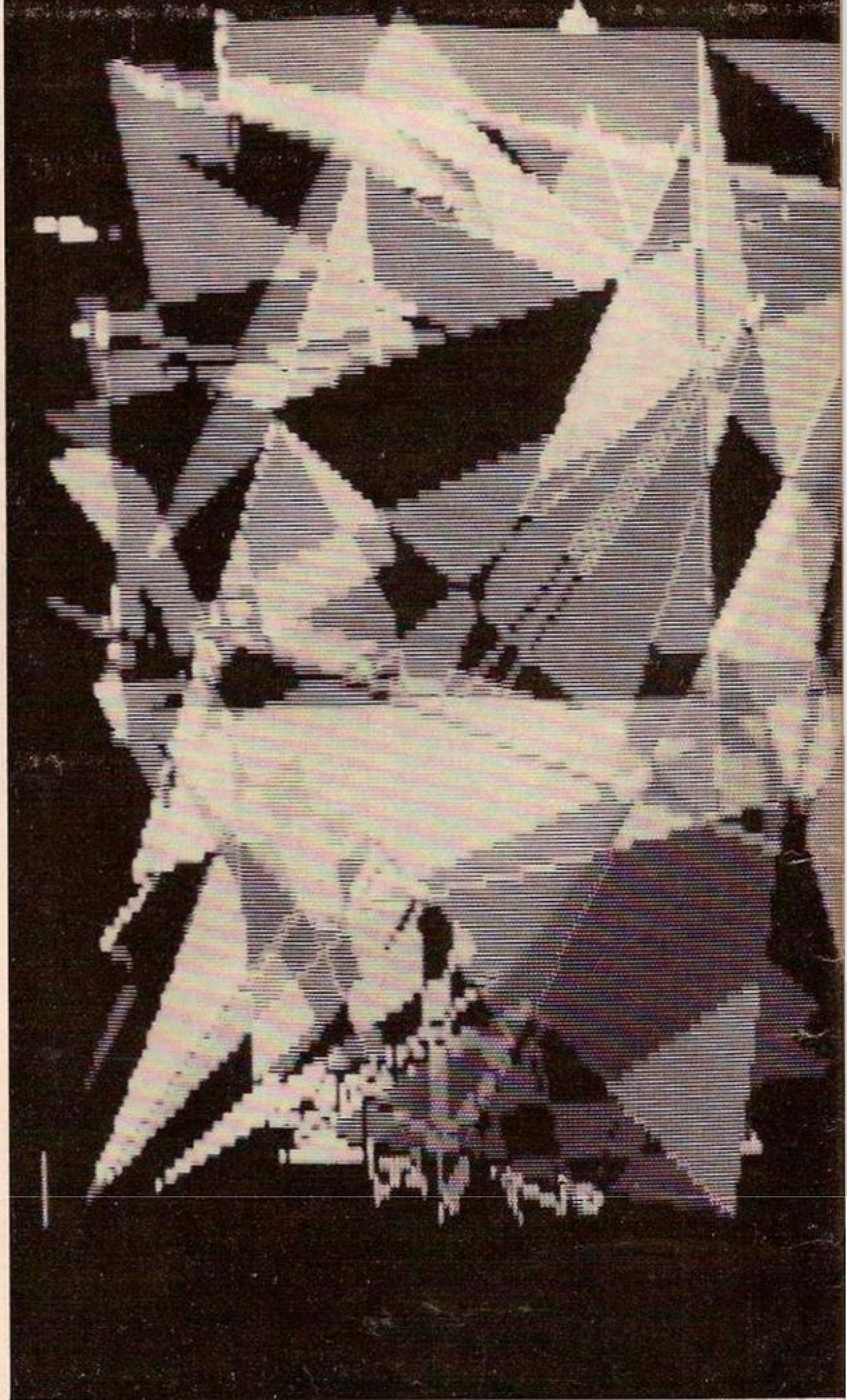
Figure 1.

All you need is a short routine to test each of the four pixels to check if it is on or off, branching as indicated by the result. Do not forget to reset the pixels and replace the cursor if you want to use the function again.

I hope this has whetted your appetite for more. However, you must help too. If you write saying what problems you would like discussed in future issues, I will endeavour to try to accommodate as many requests as possible. Further, the whole effort is wasted unless you try to translate programs from one dialect to another.

Finally, if you have discovered any good routines to simulate specialised statements from other, Basics write and let me know and I will add the best, with acknowledgment, to future articles. Next month I will discuss, among other things, String control and Print @ statements. ■

COMMANDING ON THE BBC'S



Jeremy Ruston assesses the BBC machine's colour graphics and shows how its powerful built-in Basic can be used to provide some spectacular effects on the screen.

THERE ARE a number of techniques you can use to produce startling results with the BBC Microcomputer's graphics facilities. Hidden in the back of the provisional user guide of the BBC machine you will find mention of the command VDU 19. It enables you to change the colour of an area or spot of colour on the screen, without having to redraw the object. Users of the Atari 400/800 will recognise this facility as the equivalent of their Set Color command.

To use this command effectively, you have to think about colour graphics in a new way. Rather than consider blobs of colour, think of the screen as being divided into a number of squares, where each square, or pixel, can hold a number. This number is restricted in magnitude by the graphics mode you are considering:

Mode 0 — 0 to 1
Mode 1 — 0 to 3
Mode 2 — 0 to 15
Mode 3 — 0 to 1
Mode 4 — 0 to 1
Mode 5 — 0 to 3
Mode 6 — 0 to 1

The machine is set up in such a way that each number corresponds to a specific colour. In modes 0, 3, 4 and 6, a pixel holding the number 0 will appear black, and a pixel holding 1 will appear white. In modes 1 and 5, the relationships are:

0 — black
1 — red
2 — yellow
3 — white

In mode 2 the relationship is:

0 — black
1 — red
2 — green
3 — yellow
4 — blue
5 — magenta
6 — cyan
7 — white
8 — flashing black/white
9 — flashing red/cyan
10 — flashing green/magenta
11 — flashing yellow/blue
12 — flashing blue/yellow
13 — flashing magenta/green
14 — flashing cyan/red
15 — flashing white/black

The intriguing possibilities soon become apparent once you realise that all these relationships can be changed by executing a command of the form

VDU 19, colour_number, colour,0,0,0

where

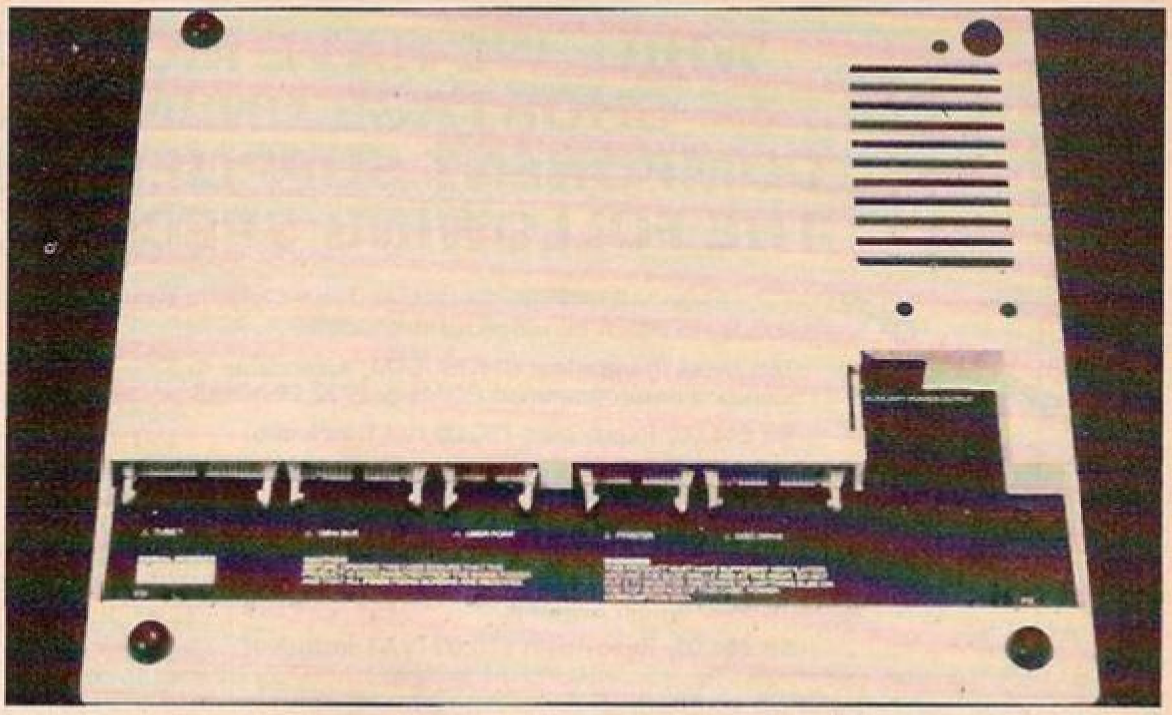
colour_number

is a number in the range of those shown in the first table. Colour is a variable with any value from 0 to 15. After this statement has been executed, any pixels holding the number "colour_number" will assume the colour indicated by "colour", according to the second table given.

There are many applications for this command. If you first set the pixels of a

BASIC MICRO





graphics screen to appear black no matter what number they hold, and you then draw a complex shape or pattern before restoring the normal relationships with VDU 20, it will appear that the drawing has been instantaneously.

For example, this program draws a circle with the screen turned off, and then restores all the normal colours very quickly. To those more used to an Apple's high-resolution graphics, this can be dramatic:

```
10 MODE 5
20 FOR colour = 1 TO 3
30 VDU 19, colour,0,0,0
40 NEXT colour
50 MOVE 640,512 + 500
60 FOR angle = 0 TO 330 STEP 30
70 GCOL 0,1
80 MOVE 640,512
90 PLOT 85,SIN(RAD(angle + 10))*500 + 640,
   COS(RAD(angle + 10))*500 + 512
100 GCOL 0,2
110 MOVE 640,512
120 PLOT 85,SIN(RAD(angle + 20))*500 + 640,
   COS(RAD(angle + 20))*500 + 512
130 GCOL 0,3
140 MOVE 640,512
150 PLOT 85,SIN(RAD(angle + 30))*500 + 640,
   COS(RAD(angle + 30))*500 + 512
160 NEXT angle
170 VDU 20
180 END
```

As a logical step from this example, if you draw many similar figures, all set to black, and then in rotation set each to a specific colour, and then back to black again, the illusion of extremely fast movement is created. This example should explain the technique:

```
10 MODE 5
20 FOR X = 0 TO 1279 STEP 20
30 MOVE X,0
40 GCOL 0, ((X DIV 20) MOD 3) + 1
50 DRAW X,1023
60 NEXT X
70 REPEAT
80 FOR colour = 1 TO 3
90 VDU 19,colour,4,0,0,0
100 TIME = 0
110 REPEAT UNTIL TIME = 20
120 VDU 19, colour,0,0,0,0
130 NEXT colour
140 UNTIL FALSE
```

The program works by drawing a series of vertical lines in each of three colours in turn. Then each colour is selectively turned to blue — line 90. A time-consuming loop, lines 100 to 110, of 0.2 of a second is set up before the colour is reset to black. The construction Repeat-Until False carries out the statements in the middle ad infinitum. This technique works very well in mode 2, where you can have up to 16 shapes to lighten and darken in turn.

Without this command it would be impossible to have any other colours but black and white in the modes which allow only two colours. Thus if you like the idea of purple text on a yellow background, try this in mode 4 or 0:

```
VDU 19,0,3,0,0,0,19,1,5,0,0,0
```

Notice how two VDU 19 commands have been effectively reduced to one.

You may have noticed on *The Computer Programme* that several programs were developed on a screen with white letters and a striped blue background. The reason for the stripes is that all this text was displayed in mode 6, which is a text-only mode with 25 lines of 40 characters.

MODE	Sets the computer in a different graphics/text mode.
MOVE	Moves the graphics cursor to a specified position.
GCOL 0,X	Sets the current graphics-plotting colour to X.
PLOT 85,X,Y	Plots a triangle between the point specified and the last two visited.
TIME	A variable which gives the number of hundredths of a second since it was last set.

Program commands.

As there are only 25 lines instead of the normal 32, so to fill up the extra space, Acorn inserted some extra, black lines between each line of text to make the text easier to read and to fill the space. Unfortunately, these extra lines are not affected by the VDU 19 command.

There appears to be a bug in the latest version of the BBC Microcomputer's monitor: when

```
VDU 19,0,23,0,0,0
```

is executed in mode 6, the screen display became blurred around the edges, rather like a photograph of a fast-moving car. ■

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LINE LABELLING EARMARKS ATOM ECONOMY

Roy Burgin sets out to show that the speed and simplicity offered by Atom line labelling make it a system worth mastering.

```
10[?18=#82; REM LABLE IS INVERSE SQUARE OPEN BRACKET
20 REM auto number/long lines
30 REM LOAD AT #8200, SET UP BY TYPING RUN, BREAK, NEW OR OLD
40 REM USE DIRECT FROM LOWER MEMORY BY TYPING G.[
50 REM M/C GETKEY ROUTINE
60 !#28E0=#85FFE620
70 !#28E4=#00006080
80 INPUT'"BEGIN AT LINE NUMBER" B," STEP" S,'
90 REM T=TOP OF YOUR PROGRAM IN LOWER MEMORY
100 T=TOP-2
110 @=5
120 ?T=13
130 T=T+1
140 REM LINE LOOP, STEP POSITIVE OR ZERO, NEGATIVE TERMINATES
150 FOR J=B TO 32767 STEP S
160 PRINT J
170 REM SET UP LINE NUMBER IN YOUR PROGRAM
180 ?T=J/255
190 T?1=J&255
200 T=T+2
210 REM LINE LOOP, INPUT CHARACTER BY CHARACTER AND STORE IN
220 REM YOUR PROGRAM, RESETTING END OF PROGRAM MARKER EACH TIME
230 FOR I=0 TO 249
240aLINK#28E0;IFI=0;IF?#80=13;G.d
250 IFI=0;IF?#80=#7F;G.a
260 IF?#80=#7F;I=I-1;T=T-1;G.a
270 IFI=249;P.$#7F;G.a
280 ?T=?#80
290 IF?T=13;I=249;G.b
300 T?1=13
310 IFI>244;P.$7
```

(listing continued on next page)

THE ATOM'S line-labelling system is a very useful programming aid which is not only fast in operation, but also makes simple renumbering possible without having to bother about Gotos and Gosubs. An added bonus is that the program is easier to follow. I would even go so far as to recommend that you do not Goto or Gosub line numbers but always use labels.

Using a mixture of both systems can lead to problems since a jump to a line number that has a label will result in a run-time error. You may think that a total of 27 labels is not adequate for a large program but as I will show, labels can be used again and again — under the right circumstances.

The 27 labels include all the inverted or lower-case letters plus an extra one that I will deal with separately as it is rather special.

Program construction

To understand the way that the labels work and to realise why Acorn decided to include them in Atom Basic, it is useful to look briefly at how a program is constructed and how the Basic interpreter sees it. A typical line in a program is made up of three parts plus the label.

The first two bytes contain a binary representation of the actual line number you have entered. This is used by the Basic editor for the normal sorting of program lines as you type them and also by the Basic interpreter for finding a numbered Goto or Gosub.

There are no link addresses as used in most other Basics, so a search for a line number in either case involves starting at the beginning of the program and working through each line until the line number or a greater one is found.

Each line is seen by the system as a number followed by a string, so the pointer must be moved on by a process similar to Len in Basic. This can be very time-consuming in a large program.

The third byte is the position reserved for the label if one is included. Otherwise, it is the start of a string of characters that make up the statement or multi-statement line. This is the only position where a line can be labelled.

The third part is the string of characters which form the statement. The length of this string is normally limited to 64 characters by the size of the input buffer located at # 100. That includes all the characters which form the line number. This size can, however, be increased up to a maximum of 252 characters and most of the Basic statements will still work perfectly — see the program called Long Lines.

Last character

The last character is the final part. The statement line must end with the normal string terminator, which is a carriage return CH 13. This is the character recognised by the Len function.

The Basic statement line is not tokenised but is entered into memory exactly as it is typed in — after binary coding the line number — and can be examined not only by the List command but also by Print$ (memory location), which prints out the string starting at that position.

This simplicity is the key to the Atom's flexibility but can have disadvantages. Much is made of the ability to shorten the Atom's Basic keywords to one or two characters followed by a full stop. This is Acorn's answer to the memory savings made by the tokenising used in Microsoft Basics.

Speed of execution is also improved by using these short forms, although in some cases the saving is negligible. For example, when I had fitted the versatile interface adaptor chip to my computer, I tested it using the program given in *Atomic theory and practice* on page 170.

This program times the execution of individual statements, and I found that the difference between Link and LI. was only 1μs. However, this was exceptional and most of the shortened forms are worth considering, even if they do reduce the readability of the program.

As mentioned, the construction of the program will affect the speed of operation of numbered Gotos or Gosubs. The usual answer to this problem, offered to Microsoft programmers, is to place often-used subroutines at the beginning of the program so that they can be located quickly, usually at the expense of program structure. The same advice applies to Atom Basic except that Acorn has gone one better by introducing the labels.

There are 26 normal labels plus an extra one which is not documented by Acorn. If Acorn were aware of the existence of the 27th label, it may have been ignored because it can be used only under certain circumstances.

Three conditions

There are three conditions which cause the label routine to be called by the operating system and the first is when you type Run. The area of memory allocated to storage of the labels is zeroed — locations # 38D to # 3C0. Each label has two consecutive bytes associated with it; a= # 38D and # 38E, b= # 38F and # 390 and so on. These locations are used to store the actual position of that label in your program.

The second conditon occurs during the execution of the program. The interpreter checks the third byte of every statement line before execution to see if it contains a label. If it does, the memory location of that label is stored in the appropriate slot; otherwise, no

(continued on next page)

(listing continued from previous page)

```
320bT?2=#FF
330 T=T+1
340 NEXT I
350 NEXT J
360 PRINT'"NO MORE LINE NUMBERS"';T=T+2
370 REM TIDY UP AND RETURN CONTROL TO LOWER MEMORY
380dT=T-3
390 ?T=13
400 T?1=255
410 $256=""
420 ?18=#29
430 !13=T+2
440 END
```

(continued from previous page)

action is necessary and the execution of the statement can continue.

The final condition is when a Goto or Gosub involves a label. The interpreter checks to see if the position of that label has been entered in the look-up table — # 38D to # 3C0 — and providing the value stored is non-zero, execution of the program will continue from the new location.

If the look-up table contains a zero, this means that the label has not yet been encountered and a normal beginning-to-end search must be made before execution can continue. Failure to locate the label produces an error message and halts the program.

Maximum use

Armed with this knowledge, we can now make maximum use of the labels available. Most of the labels we use will need to be dedicated to one particular line but there are many situations where a label can be used repeatedly in different positions.

This particular use of labels must involve entry by normal progression from one line to the next so that the label is set or reset automatically and the Goto will be a backwards jump to the last set position.

This situation occurs frequently in most programs and the same label can be used every time. I usually reserve x for this purpose. A typical case would be validity checking of input which may go something like this:

```
100 PRINT "PHASORS LOCKED IN"'
110xINPUT "HOW MUCH ENERGY TO FIRE"I
120 IF I>E;PRINT ' ' "TOO MUCH!! YOU ONLY HAVE "E" UNITS" ';G.x
130 IF I>1000;PRINT ' ' "TOO HIGH!! WE WILL OVERHEAT" ';G.x
140 IF I<10;PRINT ' ' "NOT ENOUGH TO WARM THE VALVES UP" ';G.x
150 PRINT ' ' "O.K." '
```

Once the program reaches line 150, the label becomes redundant until the next time you invoke the phasors routine, when it will be reset anyway. I have a labyrinth program where I use the x label more than 12 times and so make a considerable saving on normal use.

One problem associated with using labels is that of tracing bugs which always manage to find a way into even the shortest of programs. Of course, the longer the program, the more bugs. This problem can be greater when using labels because a Goto or Gosub to a label ignores the line number which would normally be stored for reference by the error routine, thus leaving the previously-stored line number intact. Acorn covers this by saying that an error message tells you where it thinks the error has occurred which may be several jumps from the actual error.

If you have already examined the Long Lines program, you will have seen the special label on the first line. It is the inverse-square open bracket and it is special because it is not zeroed like the rest but is left set to whatever value was there when switched on, unless that value has already been used elsewhere.

The label will be reset when a line number containing it is met or it may be set directly by typing.

!# 3C1 = # XXXX

where # XXXX is the position in memory where the label is, or could be. It does not actually need to be there providing the space does not contain another character which is essential to the Basic statement.

This opens up the possibility of a Goto of a Gosub to the middle of a line which as far as I know is not possible on any other make of computer. Try the following sequence.

```
NEW
10 END : PRINT "HELLO THERE"
!# 3C1 = # 29081 # 8208 for unexpanded Atom)
GOTO [
```

End statement

There is no other way to pass the End statement in this line. If the Long Lines program is entered into screen memory starting at # 8200, the # XXXX will be # 8203. An easier way to remember is to follow the usual sequence for entering programs into the graphics memory,

```
?18 = # 82 — enter graphics memory
NEW
LOAD "LONG LINES"
RUN
press BREAK
NEW — or OLD if you have a program in lower memory
```

You are now back in normal text memory where you can enter your own program while the long lines program stays intact with the label set. Type your program in the normal way until you reach a line that will not fit into the 64 characters allowed by the Atom, then type

GOTO [or G.[

You will be asked for a start-line number and step value and you can then continue typing in your program. The difference is that now you have auto-line numbering and the capability of typing individual lines with a length of up to half a screen.

These lines will be added to the end of your program with the Top marker adjusted accordingly. To return to normal program entry, press Return when a new line number is presented; do not use Esc. Ensure that your long lines are exactly right before pressing return as the program does not allow you to edit existing lines or insert new lines into a program — that is for the mark II version.

Beyond normal capacity

You will find that your program will Save, Load, List and Run normally with the long lines intact and you will be able to edit and insert normal-length lines in the usual way. Most Basic statements will work perfectly in long lines but remember that you are pushing the system beyond its normal capacity and strange things may happen.

For instance, an Input statement with a very long message built into it will print out the message in full but forget that it is supposed to be inputting. Also, a very long arithmetic expression will miscalculate its sums but continue without realising it. The limit in both these cases seems to be about 125 characters which is nearly twice the normal number.

These are the only two that I have found so far but there may be others, multiple If, And, Or statements are a possible candidate. These can be broken down where possible into smaller separate statements in a multi-statement line. For example:

```
200 IF A=0 AND B=0 AND C=0 AND D=0
    THEN D=10
```

Is equivalent to

```
200 IF A=0; IF B=0; IF C=0; IF D=0; D=10
```

The Long Lines program is very useful for entering large quantities of Print statements such as instructions, where you often find that you have split a word between two lines. A useful tip to prevent this is to type the word Print, or P., and the opening double quotation marks. Then move the cursor with the cursor-control keys to the beginning of the next line before typing a string of characters for output. This way you can see exactly how it will look at run time while you are typing it in, making centring and column alignment far easier. ■

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Its peculiar blend of skill and luck marks Nim out as a perfect candidate for computerisation. David Lawrence's version of the board game is for the expanded ZX-81.

WRITING A PROGRAM to play Nim raises some interesting questions about the quality of play you want your micro to exhibit. This is not the shortest Nim program possible, first, because it is written in such a way as to make its method of working transparent and secondly, because it contains a graphics representation of the game as it progresses, together with error messages for illegal moves.

The secret of playing Nim is a form of binary arithmetic which goes as follows. To make the best move it is first necessary to translate the number of counters in each pile into a binary representation, then add the binary numbers without carry.

Thus, if a game has arrived at a state where there are three piles of 8,7 and 1 respectively, their binary representations would be 1000, 0111 and 0001. Proper binary addition would result in the answer 10000 but adding them together without a carry results in 1112.

To win a game of Nim your move must result in a position where the binary sum of what is left contains only even numbers including zero. If there are piles of 8, 7 and 1 counters when your turn arrives, then you can win. If you leave the game in that state after your move, then a good player will beat you because there are odd numbers in the binary sum.

Clearly, you cannot transform each of the 1s in the binary sum to zero to calculate the winning move. That would involve removing 8+4+2 from a single pile and there is no single pile with 14 counters. The answer is to find a pile which, when represented in binary, contains a 1 in the same position as the leftmost odd number in the binary sum.

In the case of our example, the leftmost odd number in the binary sum is in the 8 position and the only pile with a 1 in the 8 position when represented in binary is the pile that actually has eight counters so that is the pile to alter.

Removing eight from the pile does not, however, solve the problem, since it would not rid us of the odd numbers in the 4 and 2 positions of the binary sum. The solution is simple: starting from the 8 position, record −8 — which rids us of one odd number — and move to the right along the binary sum and the decimal representation of the pile.

In the 4 position we find an odd number in the decimal sum, so a change has to be made to that position in one of our piles. The rule is that looking at the pile we have decided to work with, if there is a 1 in the position we want to change, then we record whatever that position represents as a minus. If there is a zero in the position that must be changed, we record the number represented by the position as a plus.

In the case of our eight pile we have now recorded −8 and +4. The 2 position in the binary sum also has to be changed and, following the same procedure, we record +2. The 1 position in our binary sum does not have an odd number, so we do not wish to make any change to our pile in the 1 position.

We have now reached the end of the binary sum and have recorded three numbers, −8, +4 and +2. Adding them together gives us −2 and that is the move we need to make. It will result in piles which, represented in binary, will be 0110, 0111 and 0001. Adding them together without carry gives us a binary sum of 0222 and that is a winning position provided that we follow the same procedure on subsequent moves.

Binary sum

The Nim program calculates the binary sum in the subroutine at 1260. In the subroutine at 1400 the leftmost odd number is recorded in one string, U$, and the other positions that need to be changed in V$. After this, the subroutine at 2330 finds a suitable pile to be altered, the necessary move is translated back from binary at 1600 and following, then the lmove is made from 1680.

If the program plays perfectly, then someone who understands the method and is prepared to use it fully on every move can still win, as long as they move first but anyone else will lose every time, which becomes a trifle boring. The program attempts to avoid this by not playing a perfect game.

The subroutine at 2330 does not, in fact, choose unerringly the correct pile to be

NIM FOR THE ZX-81.....

```
1000 GOTO 1030
1010 SAVE 'NIM'
1020 STOP
1030 GOSUB 2510
1040 GOSUB 1760
1050 GOSUB 1900
1060 IF G(1)+G(2)+G(3)+G(4)+G(5)=0 THEN PRINT "ROTTER. YOU WON."
1070 IF G(1)+G(2)+G(3)+G(4)+G(5)=0 THEN STOP
1080 GOSUB 1280
1090 IF G(1)+G(2)+G(3)+G(4)+G(5)=0 THEN PRINT "TEE-HEE. I WON."
1100 IF G(1)+G(2)+G(3)+G(4)+G(5)=0 THEN STOP
1110 IF U$="00000" THEN GOSUB 2220
1120 GOTO 1050
1130 CLS
1140 FOR I=1 TO 29 STEP 7
1150 FOR K=G(I/7+1) TO 1 STEP -1
1160 PRINT AT 20-K,I;"O"
1170 NEXT K
1180 PRINT AT 3,I-1;"(";G(I/7+1);")"
1190 PRINT AT 20,I; CHR$ (157+I/7)
1200 NEXT I
1210 RETURN
1220 PRINT AT 0,0;"32 spaces"
1230 PRINT AT 0,16;"32 spaces"
1240 RETURN
1250 REM ***********************
1260 REM BINARY SUM
1270 REM ***********************
1280 LET B2=0
1290 FOR I=1 TO 5
1300 LET T$="00000"
1310 LET N=G(I)
1320 FOR J=5 TO 1 STEP -1
1330 IF N/2<>INT(N/2) THEN LET T$(J)="1"
1340 LET N=INT(N/2)
1350 NEXT J
1360 LETB1=VAL(T$)
1370 LET B2=B2+B1
1380 NEXT I
1390 REM ***********************
1400 REM BINARY SUBTRACT
1410 REM ***********************
1420 LET S$=STR$ (B2)
1430 LET T$="00000"
1440 LET T$(6-LEN S$ TO 5)=S$
1450 LET U$="00000"
1460 FOR I= 1 TO 5
1470 LET N=VAL (T$(I))
1480 IF N/2<>INT(N/2) THEN GOTO 1510
1490 NEXT I
1500 RETURN
1510 LET U$(I)="1"
1520 LET V$="00000"
1530 FOR J=I+1 TO 5
1540 LET N=VAL(T$(J))
1550 IF N/2<>INT (N/2) THEN LET V$(J)="1"
1560 NEXT J
1570 GOSUB 2330
1580 LET S=0
1590 REM ***********************
1600 REM TRANSLATE FROM BINARY
1610 REM ***********************
1620 FOR I=5 TO 1 STEP -1
1630 IF U$(I)<>"0" THEN LET S=S+2**(5-I)
1640 IF V$(I)="1" AND W$(I)="0" THEN LET S=S-2**(5-I)
1650 IF V$(I)="1" AND W$(I)="1" THEN LET S=S+2**(5-I)
1660 NEXT I
1670 REM ***********************
1680 REM ADJUST PILES
1690 REM ***********************
1700 PRINT AT 0,0;"I WILL TAKE ";S;" FROM PILE ";P
1710 PAUSE 130
1720 POKE 16437,255
1730 LET G(P)=G(P)-S
1740 GOSUB 1130
1750 RETURN
1760 REM ***********************
1770 REM SET PILES INITIALLY
1780 REM ***********************
1790 DIM G(5)
1800 LET G(1)=INT (RND*13)
1810 LET G(2)=INT (RND*13)
1820 LET G(3)=INT (RND*(27-G(1)-G(2)))
1830 IF G(3)>16 THEN LET G(3)=16
1840 LET G(4)=INT (RND*(30-G(3)-G(2)-G(1)))
1850 IF G(4)> 16 THEN LET G(4)=16
1860 LET G(5)=32-G(4)-G(3)-G(2)-G(1)
1870 IF G(5)> 16 THEN GOTO 1800
1880 GOSUB 1130
1890 RETURN
1900 REM ***********************
1910 REM ACCEPT MOVE
1920 REM ***********************
1930 PRINT AT 0,0;"WHICH PILE?";
1940 INPUT M1
1950 PRINT M1
1960 IF M1<6 AND M1>0 THEN GOTO 2020
1970 PRINT AT 0,0;"THERE ARE ONLY FIVE PILES."
1980 PAUSE 100
1990 POKE 16437,255
```

(listing continued on next page)

altered; it simply picks the first one that looks likely to be the correct pile. Usually, it will be right and will play an unbeatable game. If, however, you can see from experience where it tends to go wrong, you can play to its weaknesses, even if you are in a losing position, making it more like a game against a human opponent.

Another solution is to allow the program to calculate a perfect move every time but introduce random mistakes. This can be achieved by replacing lines 2370 to 2400 with the following:

```
2365 LET N1 = 6-I
2370 FOR I = 1 TO 5
2375 LET N2 = G(I)
2380 FOR J = 1 TO N1-1
2385 LET N2 = INT (N2/2)
2390 NEXT J
2400 IF N2/2 <> INT (N2/2) THEN GOTO 2430
```

Making these changes will result in the program playing perfectly. A further line

```
1455 IF RND < .2 THEN GOSUB 2220
```

will produce a random move every five moves or so — more if you replace .2 with a larger figure.

One final change you might like to make is to increase the speed of the game when you are in a winning position. The program as given assumes that you are in a winning position. Its best tactic is to take only one counter, thus prolonging the game as much as possible and giving you time to make a mistake. This is done by the routine at 2230. Altering line 2300 to read

```
LET S = INT (RND*G(P) + 1
```

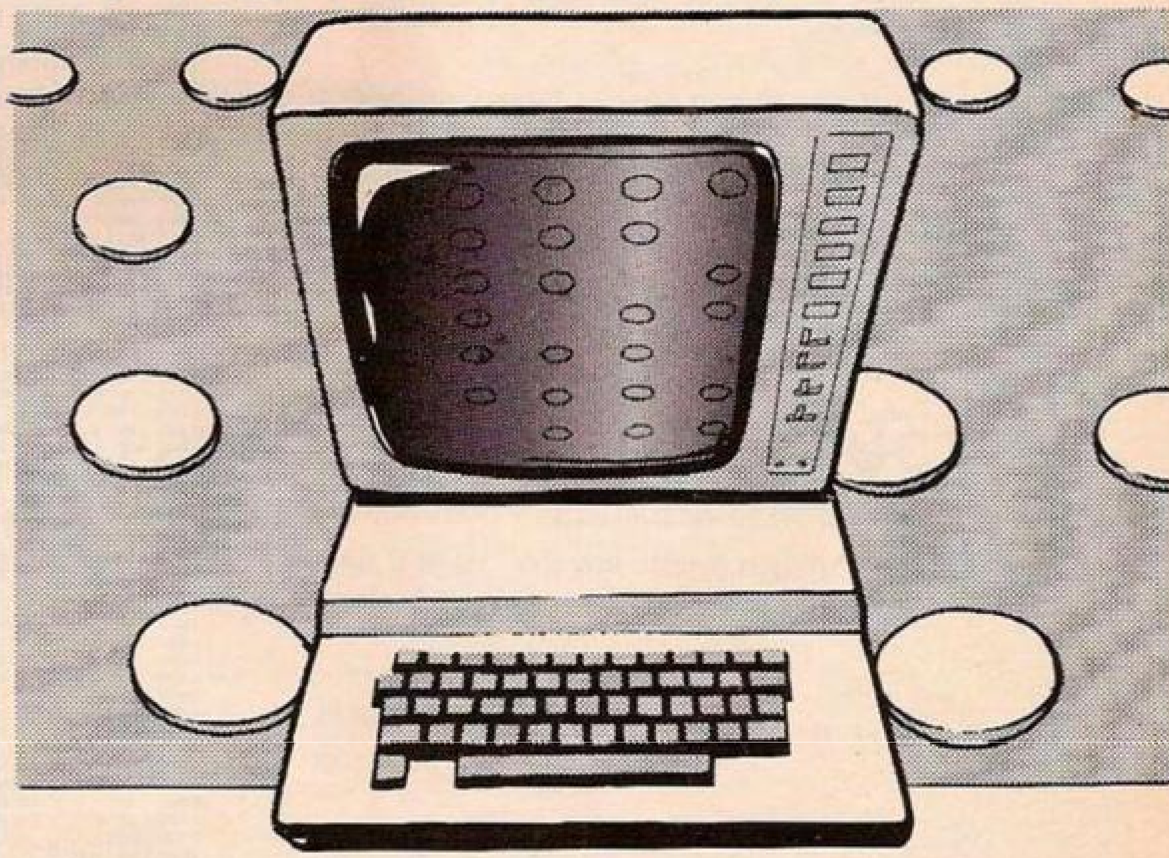
results in more counters being taken and a shorter game.

(listing continued from previous page)

```
2000 GOSUB 1220
2010 GOTO 1930
2020 IF G(M1)>0 THEN GOTO 2080
2030 PRINT AT 0,16;"NOTHING IN THAT PILE."
2040 PAUSE 100
2050 POKE 16437,255
2060 GOSUB 1220
2070 GOTO 1930
2080 PRINT AT 0,16;"HOW MANY?";
2090 INPUT M2
2100 PRINT M2
2110 IF M2>0 AND M2<=G(M1) THEN GOTO 2170
2120 PRINT AT 0,16;"YOU CANT.(2 spaces)"
2130 PAUSE 100
2140 POKE 16437,255
2150 GOSUB 1230
2160 GOTO 2080
2170 LET G(M1)=G(M1)-M2
2180 PAUSE 100
2190 POKE 16437,255
2200 GOSUB 1130
2210 RETURN
2220 REM ***********************
2230 REM SAFE POSITION
2240 REM ***********************
2250 LET S=0
2260 FOR I=1 TO 5
2270 IF G(I)>S THEN LET P=I
2280 IF G(I)>S THEN LET S=G(I)
2290 NEXT I
2300 LET S=1
2310 GOSUB 1670
2320 RETURN
2330 REM ***********************
2340 REM PILE TO BE ALTERED
2350 REM ***********************
2360 LET PILE=2**(5-I)
2370 FOR I=1 TO 5
2380 IF G(I)>=PILE AND G(I)<2*PILE THEN GOTO 2430
2400 IF G(I)-PILE >=2*PILE THEN GOTO 2430
2410 NEXT I
2420 STOP
2430 LET P=I
2440 LET W$="00000"
2450 LET C=G(P)
2460 FOR I=1 TO 5
2470 IF C/2<>INT(C/2) THEN LET W$(6-I)="1"
2480 LET C=INT(C/2)
2490 NEXT I
2500 RETURN
2510 REM ***********************
2420 REM INSTRUCTIONS
2530 REM ***********************
2540 PRINT "I WILL DISPLAY FIVE PILES OF","COUNTERS.
     ON EACH MOVE YOU CAN","TAKE ANY NUMBER OF
     COUNTERS,UP","TO AND INCLUDING ALL OF THEM--","BUT
     ONLY FROM ONE PILE.",,,"THE WINNER IS THE ONE TO
     TAKE","THE LAST COUNTER."
2550 PRINT
2560 PRINT "PRESS NEWLINE TO CONTINUE."
2570 INPUT A$
2580 RETURN
```

. . . . . AND FOR THE APPLE

Sean Overend has adapted Nim for the Apple II to cater for beginners and advanced players alike.



AFTER THE CHOICE of board size has been made by the player, the computer displays the randomly-selected pieces and gives the player the opportunity of starting. If the player fails to choose within the short time available for the decision, the computer will start.

The computer displays the state of the board after each move by the player and by itself. Games have to be played through to the bitter end — this is no hardship as the Return key need only be used once in the whole program, when the player's name is entered. Cumulative scores are displayed and you have an opportunity to change the board size, before entering a newly-shuffled game.

Now let us examine the mechanics. As might be expected, the current state of the board is stored in a one-dimensional array A. The board size is the variable Z, shown on the screen as N. The random shuffle is performed at lines 350 to 370. The code for the timed decision "Who starts?" is at lines 390 and 400. Execution is looped Z×100 times through a check of the contents of keyboard input data location — decimal 49152 on the Apple.

Subroutines 900, 1020 and 1140 are straightforward in that they merely request and check for validity the input of the player's move which consists of row and number of pieces to be taken. They then output the current state of the board on the screen.

The interesting part of the program is the code that chooses the computer's move. To understand it, you need to know the secret of the Nim strategy. Fundamentally, the technique is to move in such a way that you leave an even number of each power of two, unless you have reached the end-game.

To calculate the powers of two, you need to analyse each row into its constituent binary digits. Thus * is 2^0; *** is $2^1 + 2^0$; ******* is

(continued on next page)

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$2^2+2^1+2^0$ and so on. You then sum the total number of 2^2 in the whole board, the total number of 2^1 and the total number of 2^0. The move that will win is one that will leave an even number of each power of two on the board. The exception is the end-game, where you leave single pieces — that is, * or 2^0 — in all remaining rows. Obviously, if you want the computer to take the last piece, you must leave an odd number of single pieces.

To return to the program, lines 460 to 510 see if the end-game is in sight by counting the rows with only one piece, S, and the total number of rows remaining, L. If S=L or S+1=L, you are at the end-game stage and the code is drawn appropriately, including the final win/lose position and the accumulation of the game scores. CO is the computer's score, SC the player's.

If you have not reached the end-game, execution passes to line 840, where the power-of-two computer-move subroutine at line 1270 is called. This subroutine first calculates whether the board has an even number of each power of two, using for the purposes variables P0, P1 and P2 as Boolean, or truth, variables at lines 1290 to 1480.

If the board has an even number of each power of two, line 2010, then any move will have to be made — lines 2040 to 2090. If the board is uneven, however, then the appropriate balancing moves are calculated and made, the code for which is divided in the program for convenience into groups defined by the number of odd totals of powers of two.

```
0  REM  NIM PROGRAMME - COPYRIGHT SEAN OVEREND FEB 1981
10  HOME
20  POKE 36,17: INVERSE : PRINT "NIM": NORMAL
30  PRINT "THE OBJECT OF THIS GAME IS TO MAKE THE"
40  PRINT "OTHER PLAYER TAKE THE LAST PIECE OF ALL"
50  PRINT : PRINT
60  PRINT "THERE ARE 'N' ROWS,EACH OF WHICH MAY"
70  PRINT "CONTAIN UP TO 'N' PIECES.(N<8)"
80  PRINT "WHEN IT'S YOUR TURN, YOU MAY TAKE AS"
90  PRINT "MANY PIECES FROM ANY ONE ROW AS YOU "
100  PRINT "LIKE. YOU WILL BE ASKED FOR THE ROW "
110  PRINT "YOU WANT TO TAKE FROM FIRST, THEN THE"
120  PRINT "NUMBER TO BE TAKEN FROM THAT ROW
130  PRINT : PRINT
140  PRINT "THE COMPUTER WORKS OUT ITS MOVE RATHER"
150  PRINT "QUICKLY, AND THEN DISPLAYS THE BOARD"
160  PRINT "AS IT APPEARS AFTER ITS MOVE"
170  PRINT : PRINT
180  PRINT "REMEMBER, HE WHO TAKES THE LAST PIECE"
190  INVERSE : PRINT "LOSES": NORMAL
200  PRINT "      TYPE ANY KEY WHEN YOU ARE READY"
210  GET A$: PRINT  CHR$ (0)
220  HOME : PRINT : PRINT : PRINT
222  PRINT "YOU WILL SHORTLY BE ASKED IF YOU WISH"
223  PRINT "TO START. TYPE 'Y' QUICKLY, IF YOU DO"
224  PRINT "OTHERWISE YOU WILL LOSE THE CHANCE."
225  PRINT "YOU GET MORE TIME TO ANSWER THE "
227  PRINT "QUESTION, THE BIGGER THE BOARD"
228  PRINT : PRINT : PRINT "FIRST, TWO OTHER QUESTIONS:-": PRINT
230  INPUT "WHAT IS YOUR NAME? ";NA$: PRINT
240  DIM A(7)
250  PRINT "CHOOSE THE SIZE OF THE BOARD, ";NA$
260  PRINT "ANY NUMBER BETWEEN 3 AND 7"
270  PRINT : PRINT "N=";: GET A$: PRINT A$
280 Z =  VAL (A$)
290  IF Z < 3 OR Z > 7 THEN  PRINT  CHR$ (135): GOTO 250
300  GOTO 350
310  PRINT : PRINT "COMPUTER "CO" "NA$" "SC: PRINT
320  PRINT : PRINT "NEW GAME": PRINT
330  PRINT "DO YOU WANT A BOARD SIZE CHANGE? (Y/N)";: GET A$: PRINT A$: PRINT
340  IF A$ = "Y" THEN 270
350  FOR I = 1 TO Z
360 A(I) =  INT ( RND (1) * Z) + 1
370  NEXT I
380  GOSUB 1140
390  PRINT : PRINT "DO YOU WANT TO START? ";
395  FOR I = 1 TO Z * 100
396 Y =  PEEK (49152)
397  IF Y > = 128 THEN  GET A$: PRINT A$: GOTO 400
398  NEXT I
399  PRINT  CHR$ (135);: GOTO 450
400  IF A$ <  > "Y" THEN 450
410  GOSUB 900
420  GOSUB 1020
430 A(R) = A(R) - N
440  GOSUB 1140
450 S = 0:L = 0
460  FOR I = 1 TO Z
470  IF A(I) = 0 THEN  GOTO 510
480  IF A(I) = 1 THEN  GOTO 500
490 L = L + 1: GOTO 510
500 S = S + 1:L = L + 1
510  NEXT I
520  IF S = L THEN  GOTO 550
530  IF S + 1 = L THEN  GOTO 700
540  GOTO 840: REM  NOT ENDPLAY
550  IF S = 0 THEN  GOTO 620
560  IF S = 1 THEN  GOTO 660
570  FOR I = 1 TO Z: REM    NO CHOICE
580  IF A(I) = 0 THEN  GOTO 610
590 A(I) = A(I) - 1
600  GOTO 850
610  NEXT I
620  REM  PLAYER LOSES
630  HOME :CO = CO + 1
640  PRINT  TAB( 15): FLASH : PRINT "YOU LOSE": NORMAL
650  GOTO 310
660  REM  COMPUTER LOSES
670  HOME : PRINT : PRINT :SC = SC + 1
680  PRINT  TAB( 15): FLASH : PRINT "YOU WIN": NORMAL
690  GOTO 310
700  REM  WINNABLE ENDGAME
710  IF S / 2 =  INT (S / 2) THEN  GOTO 780
720  REM  S IS ODD
730  FOR I = 1 TO Z
740  IF A(I) <  = 1 THEN  GOTO 770
750 A(I) = 0
760  GOTO 850
770  NEXT I
780  REM  S IS EVEN
790  FOR I = 1 TO Z
800  IF A(I) <  = 1 THEN  GOTO 830
810 A(I) = 1
820  GOTO 850
830  NEXT I
840  GOSUB 1270
850  PRINT : PRINT
860  PRINT "         MY MOVE IS ": PRINT
870  GOSUB 1140
880  GOTO 410
890  REM  ****************************
900  REM  SUBROUTINE INPUT PLAYERS ROW
910  REM  ::::::::::::::::::::::::::::
920  PRINT : PRINT
930  PRINT "          YOUR MOVE"
940  PRINT : PRINT "          WHICH ROW? ";
950  GET R$:R =  VAL (R$)
960  PRINT R$
970  IF R > Z OR R < 1 THEN 990
980  IF A(R) <  > 0 THEN 1000
990  PRINT "        INVALID NUMBER, TRY AGAIN": GOTO 940
1000  RETURN
1010  REM  ::::::::::::::::::::::::::::::
1020  REM  SUBROUTINE INPUT PLAYERS NUMBER
1030  REM  ******************************
1040  PRINT
1050  PRINT "          HOW MANY? ";
1060  GET N$:N =  VAL (N$)
1070  PRINT N$
1080  PRINT
1090  IF N <  = A(R) AND N >  = 1 THEN  GOTO 1120
1100  PRINT, "        INVALID NUMBER, TRY AGAIN"
1110  GOTO 1050
1120  RETURN
1130  REM  ************************
1140  REM  SUBROUTINE DISPLAY STATE
1150  REM  ************************
1160  FOR I = 1 TO Z
1170 J = A(I)
1180  IF J = 0 THEN  GOTO 1250
1190  PRINT "           ";
1200  PRINT I;" ";
1210  FOR K = 1 TO J
1220  PRINT " *";
1230  NEXT K
1240  PRINT
1250  NEXT I
1260  RETURN
1270  REM  **************************
1280  REM  COMPUTER'S MOVE *********
1290 P0 = 0:P1 = 0:P2 = 0
1300  GOTO 1450: REM  SKIP SUBROUTINES
1310  REM  SUB1
1320 P0 =  NOT P0: RETURN
1330  REM  SUB2
1340 P1 =  NOT P1: RETURN
1350  REM  SUB3
1360 P1 =  NOT P1:P0 =  NOT P0: RETURN
1370  REM  SUB4
1380 P2 =  NOT P2: RETURN
1390  REM  SUB5
1400 P2 =  NOT P2:P0 =  NOT P0: RETURN
1410  REM  SUB6
1420 P2 =  NOT P2:P1 =  NOT P1: RETURN
1430  REM  SUB7
1440 P2 =  NOT P2:P1 =  NOT P1:P0 =  NOT P0: RETURN
1450  FOR I = 1 TO Z
1460  IF A(I) <  = 0 THEN  GOTO 1480
1470  ON A(I) GOSUB 1310,1330,1350,1370,1390,1410,1430
1480  NEXT I
1490  GOTO 2000
1500  REM  TRICKY BIT
1510  REM  SINGLE POWER SUBROUTINE
1520  IF P1 OR P2 THEN  GOTO 1590
1530  REM  POW0
1540  FOR I = 1 TO Z:X = A(I)
1550  IF X / 2 <  >  INT (X / 2) THEN 1570
1560  NEXT I
1570 A(I) = A(I) - 1
1580  RETURN
1590  IF P2 THEN  GOTO 1660
1600  REM  POW1
1610  FOR I = 1 TO Z:X = A(I)
1620  IF X = 2 OR X = 3 OR X = 6 OR X = 7 THEN 1640
1630  NEXT I
1640 A(I) = A(I) - 2
1650  RETURN
1660  REM  POW2
1670  FOR I = 1 TO Z:X = A(I)
1680  IF X > 3 THEN 1700
1690  NEXT I
1700 A(I) = A(I) - 4
1710  RETURN
1720  REM  TWO POWER SUBROUTINE
1730  IF P0 > 0 THEN  GOTO 1790
1740  FOR I = 1 TO Z:X = A(I)
1750  IF X > 5 THEN A(I) = A(I) - 6: GOTO 1780
1760  IF X = 4 OR X = 5 THEN A(I) = A(I) - 2: GOTO 1780
1770  NEXT I
1780  RETURN
1790  IF P1 THEN  GOTO 1860
1800  REM  POW0 AND POW2
1810  FOR I = 1 TO Z:X = A(I)
1820  IF X = 5 OR X = 7 THEN A(I) = A(I) - 5: GOTO 1850
1830  IF X = 4 OR X = 6 THEN A(I) = A(I) - 3: GOTO 1850
1840  NEXT I
1850  RETURN
1860  REM  P0 AND P1
1870  FOR I = 1 TO Z:X = A(I)
1880  IF X = 2 OR X = 6 THEN A(I) = A(I) - 1: GOTO 1910
1890  IF X = 3 OR X = 7 THEN A(I) = A(I) - 3: GOTO 1910
1900  NEXT I
1910  RETURN
1920  REM  THREE POWER SUBROUTINE
1930  FOR I = 1 TO Z:X = A(I)
1940  IF X = 4 THEN A(I) = 3: RETURN
1950  IF X = 5 THEN A(I) = 2: RETURN
1960  IF X = 6 THEN A(I) = 1: RETURN
1970  IF X = 7 THEN A(I) = 0: RETURN
1980  NEXT I
1990  RETURN
2000  REM  **************************
2010  IF  NOT P0 AND  NOT P1 AND  NOT P2 THEN  GOTO 2040
2020  ON P0 + P1 + P2 GOSUB 1510,1720,1920
2030  RETURN
2040  REM  GOT TO DO SOMETHING
2050  FOR I = 1 TO Z
2060  IF A(I) = 0 THEN  GOTO 2090
2070 A(I) = A(I) - 1
2080  GOTO 2100
2090  NEXT I
2100  RETURN
```

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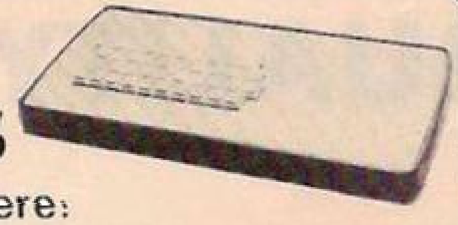
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How the ZX81 compares with other personal computers

SYSTEM IDENTIFICATION		ZX81	ZX80	ACORN ATOM	APPLE II PLUS	PET 2001	TRS 80 LEVEL I	TRS 80 LEVEL II
ROM		8K	4K	8K	8K	14K	4K	12K
GUIDE PRICE	Basic unit – inc. VAT	£70	£100	£175	£630	£435	£290	£375
	Unit plus 16K RAM (*12K RAM)	£120	£150	£285*	£630	£530	£360	£375
COMMANDS	LIST, LOAD, NEW, RUN, SAVE	●	●	●	●	●	●	●
STATEMENTS	PRINT, INPUT, LET, GOTO, GOSUB/RETURN, FOR/NEXT IF/THEN	●	●	●	●	●	●	●
	STEP	●		●	●	●	●	●
	TAB	●			●	●	●	●
ARITHMETIC	ABS, RND	●	●	●	●	●	●	●
FUNCTIONS	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING	CHR$	●	●		●	●		●
FUNCTIONS	LEN	●		●	●	●		●
	ASC(CODE), STR$, VAL, INKEY$	●				●		●
NUMBERS	FLOATING PT $\pm10^{\pm38}$	●			●	●	●	●
	INTEGERS		●	●	●	●		●
NUMERIC	A-Z			●			●	
VARIABLES	AA-ZØ				●	●		●
	An-Zn, n = any alphanumeric string	●	●					
STRING	A$ & B$						●	
VARIABLES	A$ to Z$	●	●	●				
	An$ to Zn$ n = any alphanumeric character				●	●		●
NUMERIC	SINGLE DIMENSIONAL		●	●			●	
ARRAYS	MULTI DIMENSIONAL	●			●	●		●
DISPLAY	ROWS	24	24	16	24	25	16	16
	COLUMNS	32	32	32	40	40	64	64
	LOW RES GRAPHICS (<7000 pixels)	●	●	●	●	●	●	●
	HI RES GRAPHICS (>40000 pixels)			●	●			
SPECIAL	USR (CALL, LINK)	●	●	●	●	●		●
FEATURES	PEEK, POKE (OR EQUIV)	●	●	●	●	●		●

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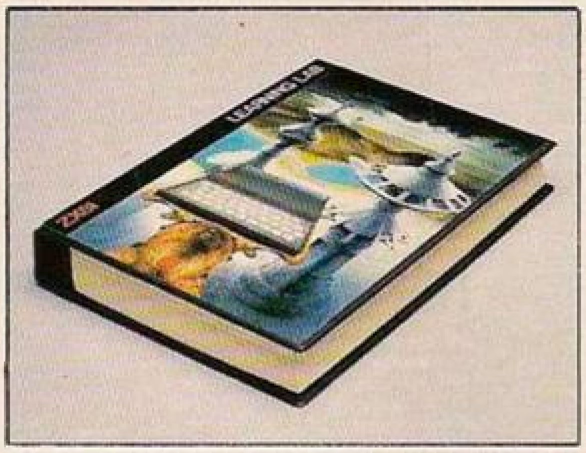


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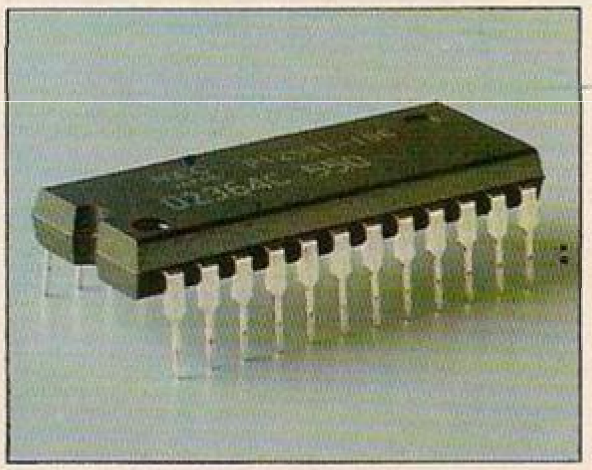
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

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VIC COLOUR GRAPHICS

Nick Hampshire shows how you can exploit the Vic's graphics-character generator to plot high-resolution graphics.

HIGH-RESOLUTION point plotting uses exactly the same principles as the generation of user-definable characters. It entails filling the video RAM with each of the 255 character codes — only half the screen can be used with eight-by-eight characters. The RAM character generator can then be used as a high-resolution memory-mapped display.

If all bytes in the RAM character generator are set to zero, then the screen is blank. If you then set one bit in one of the characters, a single high-resolution dot will appear on the screen. The relationship between a single dot on the screen, the locations in the RAM character generator, and the code value in each of the video memory locations is shown in figure 1.

It shows that the basis of high-resolution plotting is simply filling the video RAM corresponding to the screen area of the high-resolution display with successive and incremented code values. The rest is a matter of calculation to ensure that the correct bits are set in each of the eight bytes corresponding to each of the character codes used in the video RAM.

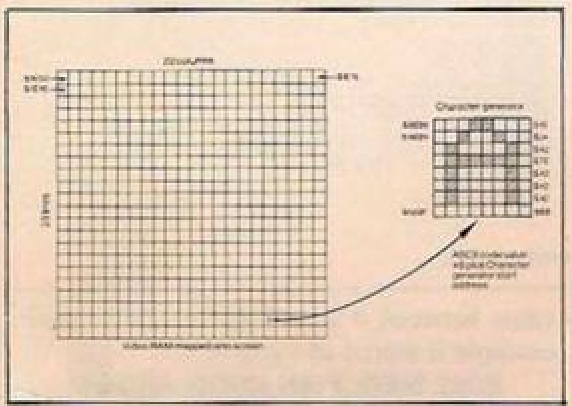


Figure 1. Relationship between character-generator locations and video memory code.

A high-resolution plotting program consists of two parts; the initialisation and the point-plot subroutine. Initialisation sets the registers of the 6561 for a user-definable character generator, lowers the top of memory to protect that character generator, enters the correct data into the video and colour RAMs and clears the contents of the RAM character generator.

The point-plot subroutine is called whenever a point is to be plotted or erased. It consists of a routine to calculate, from given X and Y co-ordinates, which bit in which byte of the RAM character generator is to be set or erased.

It should be noted that the area of the screen devoted to high-resolution plotting can vary from just a few adjacent character spaces to the whole screen. To do this, the 6561 is initialised to display eight-by-16 characters rather than the normal eight-by-eight. That requires the RAM character generator to be enlarged to 4K.

```
6 REM * INITIALISE 6561 REGISTERS
7 PRINT"▣"
8 POKE36867,128
9 POKE36865,60
10 F(8)=0:F(0)=128:F(1)=64:F(2)=32:F(3)=16
20 F(4)=8:F(5)=4:F(6)=2:F(7)=1
30 FORQ=0TO255
32 POKE7680+Q,Q
34 POKE38400+Q,2
36 NEXT Q
40 FOR Q=5120TO5120+255*8
42 POKEQ,0
44 NEXT Q
45 POKE36869,253
46 POKE36866,PEEK(36866)OR128
47 POKE36867,150
60 REM
61 REM *PLOT GRAPH OF FUNCTION IN LINE 90
62 REM
80 FOR C=0TO175
90 L=45+40*SIN(C/10)
91 REM
92 REM *HIGH RESOLUTION POINT PLOT ROUTINE
93 REM
100 A=5120
110 LR=L/8
120 LA=INT(LR)
130 A=A+(LA*176)
140 LR=(LR-LA)*8
300 CR=C/8
310 CA=INT(CR)
320 A=A+(CA*8)
325 A=A+LR
330 CR=INT((CR-CA)*8)
400 POKEA,PEEK(A)ORF(CR)
500 NEXTC
550 REM
551 REM *WAIT FOR KEY PRESS THEN RETURN
552 REM *SCREEN TO NORMAL
553 REM
600 GETA$:IFA$=""THEN600
1000 POKE36869,240
1010 POKE36866,150
1020 POKE36867,174
1030 POKE36865,38
```

Program 1. High-resolution plot of a function.

An example of a set of Basic routines to plot points in high resolution, plus lines and circles, is contained in program 1. These routines use a 2K character generator and eight-by-eight characters so the display occupies only half the screen. The 6561 registers have been used to centre the display.

The Vic has two modes of colour operation: high-resolution mode and multicolour mode. The operating mode and the colours used are determined by the contents of control registers 15 and 16 of the colour video RAM. The colour video RAM is located in a 506-byte block of memory starting at location $9600 — 38400 decimal.

If there is more than 8K of user memory, the starting location of colour RAM moves down to $9400 — 37888 decimal. The colour video RAM is only four bits wide, bits 0 to 2 are used to select the character colour, and bit 3 is used to determine whether that character is in high-resolution or multicolour mode.

The high-resolution mode is selected by having bit 3 of the video colour RAM set to zero. This is the normal mode of operation and in it there is one-to-one correspondence between character generator bits and the dots displayed on the screen. This means that all 1 bits will be displayed as dots of one colour and all 0 bits as dots of another colour.

Each character has two colours, a foreground — all the 1 bits — and a background colour — all the 0 bits. One of these colours is determined by the first three bits of the video colour RAM and the other by bits 4 to 7 of control register 16. In normal operation, the foreground colour is stored in the video colour RAM and the background colour, which is common to all characters displayed on the screen, is stored in register 16.

This can be reversed so that all characters have the same foreground colour which is also determined by register 16 and different background colours set by the contents of the colour video RAM. Whether a common foreground or a common background is selected depends on the contents of bit 3 of control register 16.

If bit 3 is set to 1, the display will have differently-coloured characters on a common background colour; if bit 3 equals 0, all characters will have the same colour against a different colour background. In addition to the foreground and background colours, the 6561 allows the colour of the border around the display area to be changed. This is selected by bits 0 to 2 of control register 16.

The colours which can be displayed on the Vic are divided into two groups. The first group has eight colours. These colours can be used for the foreground or video colour RAM stored colour, and the border. The second group has 16 colours which can be used for the background colour — also stored in control register 16 — and for the auxiliary colour. This is used only in the multicolour mode. The colours available in each of the groups are shown in table 1. To test the capabilities of high-resolution mode, carry out the following operations. Set bit 3 of register 16 for common

Auxiliary/background colours	Border/Character colours
0 Black	Black
1 White	White
2 Red	Red
3 Cyan	Cyan
4 Magenta	Magenta
5 Green	Green
6 Blue	Blue
7 Yellow	Yellow
8 Orange	
9 Light-orange	
10 Pink	
11 Light-cyan	
12 Light-magenta	
13 Light-green	
14 Light-blue	
15 Light-yellow	

Table 1. Background and character colour codes.

background or common foreground. For common foreground:

POKE 36879, PEEK (36879) AND 247

For common background:

POKE 36879, PEEK (36879) OR 8

Set the common background/foreground colour in bits 4 to 7 of control register 16. There are 16 colours possible. It is the colour number as shown in the table which is stored in the register, as in the following example where variable C is the colour and is set to a value between 0 and 15:

POKE 36879, PEEK (36879) AND 15
POKE 36879, PEEK (36879) OR (C*16)

(continued on next page)

(continued from previous page)

return to normal with

POKE 36879,27

Set the border colour in bits 0 to 2 of control register 16. There are eight possible border colours and it is the colour number shown in table 1 which is stored in the register, as in the following example were variable C is the colour set to a value between 0 and 7:

POKE 36879, PEEK (36879) AND 248
POKE 36879, PEEK (36879) OR 0

Put the colour code for each character to be displayed into the corresponding location in the colour video RAM. There are eight possible character colours — see table 1 — they are stored in bits 0 to 2 of the 506 locations in the colour video RAM.

This is done automatically in a Print statement where the character colours can be embedded in the string as colour commands. If Poke commands are used to put characters into the video RAM then the colour code must also be Poked into the corresponding location in the colour RAM.

Given the column number, Col, and the line number, Lin, of the display plus the ASCII code of the character, A, and the colour code for that character, C, the following routine will put the character and its colour into the correct locations in the two video RAMs:

```
100 Q = LIN*22+COL
110 POKE 38400+Q,C
120 POKE 7680+Q,A
```

The multicolour mode is selected by having bit 3 of the video colour RAM set to 1. In this mode there is a two-to-one correspondence between character generator bits and the dots displayed on the screen. This means that two bits of the character-generator matrix for that character code correspond to one dot on the screen, and the colour of that dot is determined by the two-bit code in the character generator.

The multicolour mode is not suitable for use with the ROM-based character generators but can be very effective when used with a user-definable RAM character generator. This is because the ROM character generators are designed for high-resolution mode displays, where each bit in the character matrix represents a dot position on the screen.

In multicolour mode, the character generator contains the colour of each dot by using two bits to represent each display dot. With a ROM character generator, most characters will thus appear as an array of differently coloured points rather than a character.

The two bits of the character-generator character matrix, which represents each screen dot, select one of four colours for that dot in multicolour mode. The four codes created by these two bits tell the 6561 where to find the colour information for the dot. The two-bit code is not itself a colour code; it is simply a pointer to four different colour codes, giving greater flexibility, as each code pointed to has either three- or four-bit resolution.

The use of a simple two-bit pointer, combined with bit 3 of the colour video RAM being used to determine the colour-display mode means that it is possible to mix high-resolution and multicolour characters in a display.

```
6 REM *INITIALISE 6561 AND CHAR GEN
7 REM
8 POKE36867,128
9 POKE36865,60
10 F(8)=0:F(0)=128:F(1)=64:F(2)=32
20 F(3)=16:F(4)=8:F(5)=4:F(6)=2:F(7)=1
35 FOR O=0TO255
37 POKE7680+O,0
38 POKE38400+O,2
39 NEXTO
40 FORQ=5120TO5120+255*8
41 POKEQ,0
42 NEXTQ
45 POKE36869,253
46 POKE36866,PEEK(36866)OR128
47 POKE36867,150
90 REM
91 REM *DATA FOR LINE DRAWING
92 REM *START AT COORDINATES X1,Y1
93 REM *END AT COORDINATES X2,Y2
94 REM
100 READX1,Y1,X2,Y2
105 IFX1=255THEN200
110 GOSUB1000
120 GOTO100
150 DATA 80,10,100,40
151 DATA 80,10,60,40
152 DATA 95,30,95,80
153 DATA 65,30,65,80
154 DATA 65,80,95,80
155 DATA 85,80,85,60
156 DATA 90,80,90,60
157 DATA 85,60,90,60
158 DATA 70,75,70,60
159 DATA 75,75,75,60
160 DATA 70,75,75,75
161 DATA 70,60,75,60
162 DATA 70,50,70,35
163 DATA 75,50,75,35
164 DATA 70,50,75,50
165 DATA 70,35,75,35
166 DATA 85,50,85,35
167 DATA 90,50,90,35
168 DATA 85,50,90,50
169 DATA 85,35,90,35
170 DATA 20,80,20,50
171 DATA 22,80,22,50
172 DATA 120,80,120,50
173 DATA 122,80,122,50
188 REM *END OF LINE DATA
189 DATA 255,255,255,255
190 REM
191 REM *DATA FOR DRAWING CIRCLES
192 REM *CENTRE AT COORDINATES CX,CY
193 REM *RADIUS R
194 REM
199 DATA 255,255,255,255
200 CX=21:CY=40:R=10
210 GOSUB3000
220 CX=121:CY=35:R=15
230 GOSUB3000
240 GETA$:IFA$=""THEN240
1000 REM
1010 REM *LINE DRAWING ROUTINE
1020 REM *USES DATA FROM LINE DATA TABLE
1030 REM
1200 XD=X2-X1
1210 YD=Y2-Y1
1230 A0=1:A1=1
1240 IFYD<0THENA0=-1
1250 IFXD<0THENA1=-1
1270 XE=ABS(XD):YE=ABS(YD):D1=XE-YE
1280 IFD1>=0THEN1320
1290 S0=-1:S1=0:LG=YE:SH=XE
1300 IFYD>=0THENS0=1
1310 GOTO1340
1320 S0=0:S1=-1:LG=XE:SH=YE
1330 IFXD>=0THENS1=1
1340 REM
1350 TT=LG:TS=SH:UD=LG-SH:CR=LG-SH/2
1355 D=0
1360 REM
1370 C=X1:L=Y1:GOSUB2100
1380 IFCT>=0THEN1420
1390 CT=CT+TS:X1=X1+S1:Y1=Y1+S0
1410 GOTO1460
1420 CT=CT-UD:X1=X1+A1:Y1=Y1+A0
1460 TT=TT-1
1470 IFTT<0THENRETURN
1480 GOTO1370

2000 REM
2010 REM *POINT PLOT ROUTINE
2020 REM *USED BY LINE AND CIRCLE DRAW
2030 REM *ROUTINES
2040 REM *C=X COORDINATE
2050 REM *L=Y COORDINATE
2060 REM
2100 A=5120
2110 LR=L/8
2120 LA=INT(LR)
2130 A=A+(LA*176)
2140 LR=(LR-LA)*8
2300 CR=C/8
2310 CA=INT(CR)
2320 A=A+(CA*8)
2325 A=A+LR
2330 CR=INT((CR-CA)*8)
2400 POKEA,PEEK(A)ORF(CR)
2500 RETURN
2600 GETA$:IFA$=""THEN2600
3000 REM
3001 REM *CIRCLE DRAWING ROUTINE
3002 REM *OX AND OY ARE OFFSET VARIABLES
3003 REM *WHICH DETERMINE WHETHER A CIRCLE
3004 REM *OR ELIPSE IS DRAWN
3005 REM
3010 OX=1:OY=1.2
3020 A=2*
3030 N=100
3040 INC=(A-0)/N
3050 FORI=0TOASTEPINC
3060 X=R*SIN(I):X=INT(X*OX+CX+.499)
3070 Y=R*COS(I):Y=INT(Y*OY+CY+.499)
3080 L=Y:C=X:GOSUB2100
3090 NEXTI
3100 RETURN
```

Program 2. High-resolution plot of points, lines and circles.

The colour of the dot can be either the background colour, the foreground colour, the exterior border colour or a special auxiliary colour, information on which is stored in bits 4 to 7 of control register 15. The multicolour mode select codes are:

0 0 — Background colour
0 1 — Exterior border colour
1 0 — Foreground colour
1 1 — Auxiliary colour

The use of the multicolour mode can be summarised using the following example: Set the background colour to one of the 16 colours. This colour code is stored in the following example in variable C which will have a value between 0 and 15:

POKE 36879, PEEK (36879) AND 15
POKE 36879, PEEK (36879) OR (C*16)

Set the exterior border colour to one of the eight colours. This colour code will have a value between 0 and 7 and in the following example is stored in variable C:

POKE 36879, PEEK (36879) AND 248
POKE 36879, PEEK (36879) OR C

Next, set the foreground colour to one of the eight colours by Poking the colour code into the colour video RAM location, corresponding to the location of the displayed multicolour character.

Since it is bit 3 of the colour video RAM which determines whether a character is displayed in high-resolution or multicolour mode, then 8 should be added to the colour-code values for all characters to be displayed in multicolour mode.

Now set the auxiliary colour code to one of the 16 colours. This colour code will have a value between 0 and 15 and in the following example is stored in variable C:

POKE 36878, PEEK (36878) AND 15
POKE 36878, PEEK (36878) OR (C*16)

Bit 3 of control register 16 has no function in multicolour mode but should be set to the normal value of 1, unless otherwise required when mixing both colour display modes.

Finally, set the character matrix for each charcter to be displayed as in figure 2. This example is for a character in a user-definable character generator starting at location 5120. The character had a code value of 0 and will show each of the four colours available in multicolour mode characters. ■

Figure 2. Character-matrix settings.

byte	76 54 32 10	Hex	Location
0	00 01 10 11	1B	5120
1	00 01 10 11	1B	5121
2	00 01 10 11	1B	5122
3	00 01 10 11	1B	5123
4	00 00 00 00	00	5124
5	01 01 01 01	55	5125
6	10 10 10 10	AA	5126
7	11 11 11 11	FF	5127

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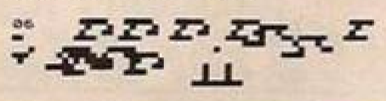
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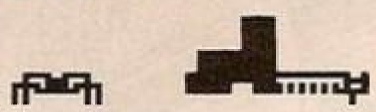
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BUG SPLAT

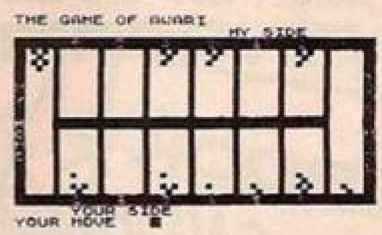


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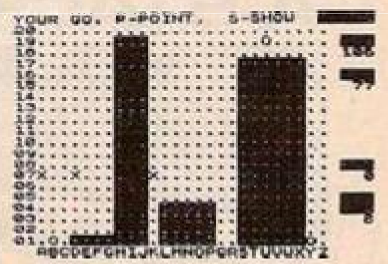
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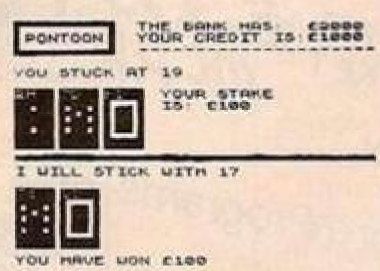
AWARI



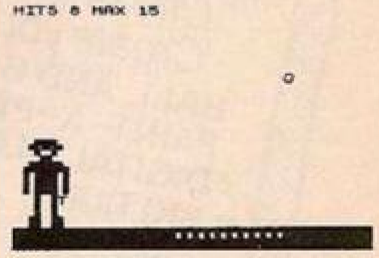
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Computing the remedy for human handicaps

To mark Information Technology Year, *Your Computer* is sponsoring a major competition whose aim is the development of imaginative and useful devices through which disabled people can make use of microcomputers. John Dawson sets the scene and lays out the competition rules.

A COMPUTER EXPERT claimed recently that we are making use of only five percent of the microcomputer's potential. Another expert said that home computers are nothing more than toys — nobody has any applications for the computer that demand the use of automatic data-processing equipment.

For example, you can add up the cheques you have issued in a month and the money that has been credited and debited to and from your account without having access to a home-finance package on a microcomputer. There is no absolute requirement for you to have a microprocessor to gain control of your central heating; Monopoly, snakes and ladders and chess were all successful games before the University of Manchester built the first digital computer.

Bright ideas

The *Your Computer* competition for microelectronics for the disabled means that it does not matter whether you have a computer or whether all you have are bright ideas — you can enter.

First, let us reject the idea that the disabled are freaks of nature who ought to be kept out of sight in hospitals built when Victoria ruled the Empire. People who are disabled or handicapped are just people who are less able in some area than you or I. We are all disabled in some way — I am overweight and cannot run; others are handicapped mentally because of an accident at birth, still others are physically disabled because of polio, spina bifida or motorcycle accidents.

There is a spectrum of disability with no arbitrary break-points and each of us may become disabled at any time. Growing old imposes handicaps on many people, and as acute health care in the U.K. improves, so more people will have to face the chronic disabilities of old age.

Microelectronics and computers promise enormous gains to people who are less able in one area or another than the "average" person. Many of the most useful aids are extremely simple in design. For example, some are designed for basic tasks such as helping someone into or out of the bath or to use a lavatory.

However, many of the aids examined by the Institute for Consumer Ergonomics at Loughborough University have failed to do what a user wants because of bad design — not all aids for disabled people meet the needs of the people who will use them.

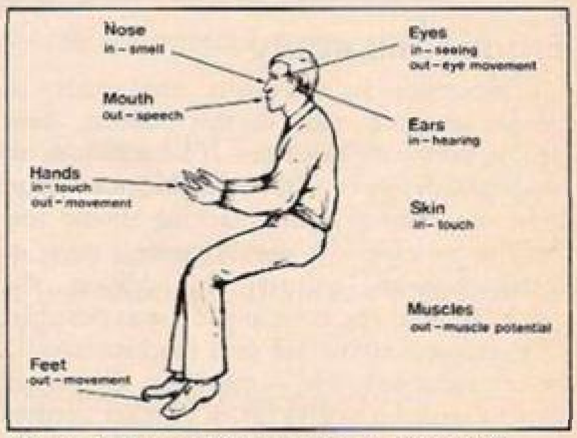


Figure 1. Human "input-output channels".

From a seat in the bath to the most sophisticated microcomputer program, an aid for the disabled must succeed on two counts — technical engineering and ergonomics.

Microelectronic aids for the disabled need to be:

- Reliable
- Compatible
- Durable, strong and safe

Ideally, a microelectronic aid that is about to fail or is actually failing should notify someone other than the disabled person that it will no longer be able to carry out its designed purpose. If it is made for somebody who is not severely handicapped it should "fail gracefully", and allow the handicapped person to call for technical assistance.

An increasing number of microelectronic aids for the disabled will be marketed in the U.K. Compatibility between different pieces of equipment is important in increasing the size of the market, and reducing production costs.

Joystick control

For example, a joystick control might be used to move chess pieces on an electronic chessboard. The physical layout of the connecting plug and socket between the joystick and the computer as well as the allocation of signals to each pin should be arranged according to a published standard.

Durability, strength and safety are all important in the technical design of microelectronic aids. The person using a piece of microelectronic equipment should be reasonably certain that it will continue to work for the foreseeable future. Similarly, the designers of equipment for the disabled must be aware that handicapped people may be caught off balance more easily than an able person and may lean heavily and suddenly on anything that comes to hand.

A disabled person may fall and pull on

(continued on next page)

Figure 2. Current possibilities for input and output of information.

Output from the computer	
Visual display units	Widely used. Several basic types exist with different manufactured versions.
Printers	As for visual display units.
Voice	Research prototypes available and a few manufactured versions.
Smell	Little work at present. Possible uses in fault detection.
Touch	Research on aids for the blind.
Input to the computer	
Keyboards	Widely used. Several basic types exist with different manufactured versions.
Character Recognition	A number of manufactured versions exist. Increasing use being made of this technology.
Voice	Research prototypes exist. Some manufactured versions are available.
Finger/hand/arm movement	Several basic types exist — light-pens, digitising panels, touch panels, joysticks — with manufactured versions.
Leg movement	Little use made of this channel although the technology exists.
Eye movement	Research — mainly for the military.
Muscle potential	Research on direct electro-physiological control of artificial limbs and also on direct brain electric signal control of external units.

(continued from previous page)
connecting wires or may be unable to get up again in order to reach an alarm switch. If a handicapped person is going to use a suck/blow switch for putting information into a computer it is important that the mouthpiece and the switch are electrically isolated to accepted safety standards. A person suffering from epilepsy, unstable diabetes or who has serious heart disease may need to take particular care with any equipment that moves or could trap a hand or an arm.

Ergonomic study

Ergonomics is essentially the study of people at work and, in this context, how people work with machines. If a machine or an electronic device is to be acceptable to a person it is important that the machine should feel right to its user — it should create a sense of consistency and security. In addition, the machine should be as simple to use as possible.

A microelectronic aid or a machine should be comfortable to use — otherwise the person may be tempted to give up, or to make excuses that the machine is not what they want, or to say it is inaccurate, or simply to reject it out of hand.

Anybody using a machine will do it better if the device is satisfying to look at and if it is seen to enhance the appearance of the user's environment.

The *Your Computer* competition is about using your computer to design something that will help other people. I cannot introduce it better than by printing a letter from a speech therapist in Scotland: "We read the article on IT 82 in *Therapy* with much interest. Here at our residential school we find it difficult to equip out very severely physically-handicapped children with suitable input switches for the electronic aids available. Also, we are trying to learn as much as we can about microcomputers in the hope that eventually they may be available here, too.

"Any information we can get on literature on the subject would be most welcome. We ran a day course in November and we were overwhelmed by the response — so the need and interest is there. One of our biggest problems is adapting switches for certain children as we have no technician — also these switches are so expensive. If they were on the mass market it would be marvellous".

The prizes and rules of the competition are described at the end of the article and you should note that there are two groups in the competition — one for people under 18 years old on 31 August 1982, and the second for individuals or clubs and organisations with access to hardware and software.

You need to write not more than 2,000 words describing a special-purpose device to accept information into a microcomputer from someone who is disabled, using that input to control programs that will carry out a useful function for that person.

Practical needs

In group 1 the judges are looking for original and stimulating ideas, organised around the practical needs of someone handicapped in a particular way. In group 2, the judges hope to see a working, prototype device with a small computer program that can be used to control ordinary, commercially-available software.

Figure 2, taken from a National Computing Centre publication, *Designing Systems for People*, may stimulate your imagination. It sets out the state of the art in 1980 for in- and out-putting information for computers.

Competition Rules

- The competition will be divided into two sections: group 1 for people under the age of 18 on August 31,1982; and group 2 for all other individuals, clubs and organisations.
- All entrants must write up to 2,000 words on building a device to which will provide practical help for disabled people. This must take the form of a device which will help disabled people to use a microcomputer keyboard, *or* a device which works in conjunction with a microcomputer to allow a disabled person to perform an activity which their disability normally prevents them from performing or enjoying.
- Entrants for group 2 should also build a prototype device.
- The winners of the competition will be the individual, groups or clubs who, in the opinion of the judges, invent the most original and useful device for disabled people to use with a microcomputer. Preference will be given to entries which make the widest possible use of commercially-available equipment and commercial or published software.
- The names of the winners will be printed in the January 1983 issue of *Your Computer.*
- It is hoped to announce the winning entries at the Information Technology Year 1982 conference to be held at the Barbican Centre, London, in December.
- Entries to the competition cannot be acknowledged.
- No employees of IPC Business Press or their relatives may enter the competition.
- The decision of the judges is final.
- No correspondence on the result of the competition will be entered into.
- IPC Business Press assumes no responsibility or liability for any complaints arising from this competition.

Prizes

- The winner of group 1 of the competition will be awarded a BBC Microcomputer.
- The winner of group 2 of the competition will be awarded an Epson MX-80FT printer.
- The top 10 runners up will receive copies of Asimov, a word-processing package for the Microtan.

Traditionally, mass-producing and marketing the product are neglected areas. The cost of the product is important set against the cost of existing products and the value of the device to a person who is elderly or disabled. The compatibility of the device with other microelectronic equipment may be a crucial factor in a company's decision to market an aid.

Distribution question

How is the device to be distributed? Would it be sold directly to people who are handicapped through High Street retail shops or will it have a limited distribution through charitable organisations specialising in helping the disabled? What is the market for the product?

Is the aid something that will extend the performance of all the 960,000 handicapped people in the U.K. or is it intended for a more specialised market, helping those who are severely disabled or, conversely, those whose disability while not severe is comparatively specialised? Is the product easy to service after it has been sold? How long will it take a service engineer to find and what spares and equipment will he have to carry to put the device back into working order?

The use of microelectronic aids for disabled people presents the technical design, ergonomics and marketing factors in sharp, black-and-white relief. However, all these questions are important to the development of microelectronic equipment in general.

Thinking about design for the disabled has valuable spin-offs for people who are not handicapped. Good design is universal and if you succeed in making something that is attractive and can be used easily by an elderly or handicapped person, the chances are that it will also be successful for a large number of able people looking for a tool to carry out a particular job.

Piecemeal research

Do not be discouraged from entering the competition by the work already being done in this area. So far, research into the needs of the disabled has tended to be piecemeal and uncoordinated. While the Department of Industry is discussing a plan, costing perhaps £2 million, to take computerised aids available to disabled people during Information Technology Year, the Department of Health and Social Security — formally responsible for providing technical aids for the disabled — is not enthusiastic about new schemes because of the novel technology that is involved.

The Health Section of Information Technology Year 1982 will encourage the marketing of the winning designs in the competition and will ensure that the investors of a successful design receive an adequate royalty for equipment that is sold. CAP Scientific Ltd is an offshoot of Computer Analysts and Programmers Ltd and the company has agreed to assess the entries to the competition with a view to production and subsequent marketing.

Entries for the competition must be sent to John Dawson, IT 82 Health Section, *Your Computer*, IPC Electronic Press, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, and must arrive not later than 31 August 1982. ■

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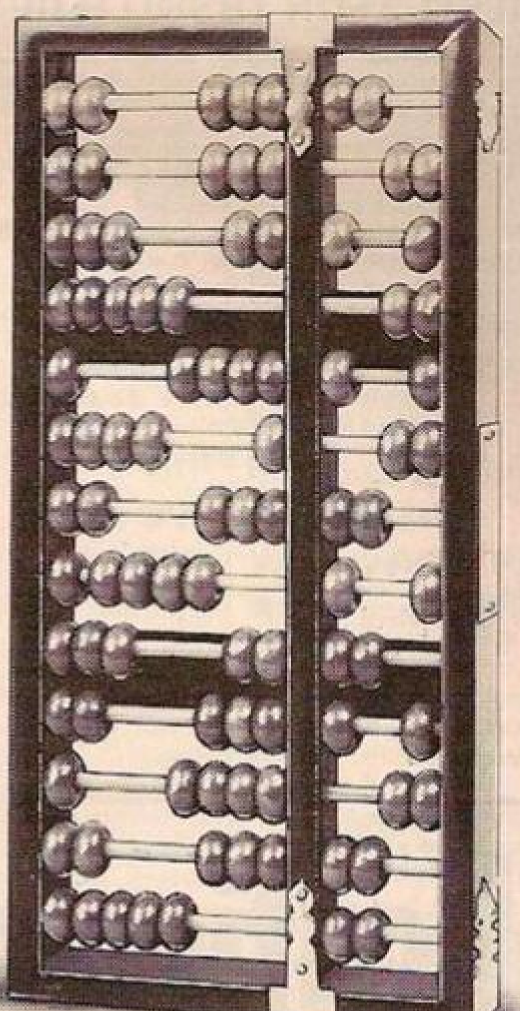
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MICRO ROBOTS

I have been an avid reader of *Your Computer* since its inception and can assure you that I look forward to each issue. I use a ZX-81 for general office use although the moment has now arrived where I shall have to look to a larger micro. I have a small hand-operated box-making machine which has three movements, one of which includes measurement. I can see how to operate the machine in all but the measurement side if I were to semi-automate it. Can you give me the name of any product or company that specialises in line measurement to an accuracy of 1mm. and, of course, using the ZX-81 program for this purpose?

J C R Wood,
Wincolmlee,
Hull.

THANK YOU for your comments on the magazine. The short answer to your question is, no. We suggest you contact the firms mentioned elsewhere on this page, and in the advertisements in this issue, which deal in hardware for the ZX-81, but doubt they could help you. Next time you are in London you might like to visit the Science Museum where — in the Challenge Of The Chip exhibition — there is an Acorn Atom controlling a robot arm painting a model car. The robot's movements are all under software control. This may well be a suitable unit for you. Although we have heard that a ZX-81 robot arm is possible, we have not seen one in action.

PET BOOKS

I would like to buy a book on Basic on an old-ROM 8K Pet, covering all the commands available in this version of Basic.

J Smith,
Lancing,
West Sussex.

THE BOOK we would recommend is called *Pet Basic, Training Your Pet Computer*, by Ramon Zamora, Robert Albrecht and William Scarvie. Published by the Reston Publishing Company, this book takes you through Pet Basic from very first principles. It is suitable for any ROM Pet as a first guide. Unfortunately, at £11 it is very expensive in the U.K. Chapters include "Getting to know your Pet", "Training your Pet to speak Basic" and "The world of Pet variables". The text is easy to understand, and there are some demonstration programs. Once you've got that under your belt, you might like to try a follow-up volume *32 Basic Programs for the Pet Computer* by Tom Rugg and Phil Feldman. Published by the dilithium Press, this book retails for around £7. Programs include Flashcard, Stopwatch, Roadrace, Groan and Wari.

ZX KEYBOARD

I am the owner of a ZX-81 and would like some advice on which add-on keyboard I should buy for it, as the existing one is very slow to work with.

Martin Smith,
Cardiff.

THERE ARE a large number of keyboards on the market for the ZX-81. It may reassure you to know that we have never had a single complaint from anyone regarding the extension keyboards they have bought for the ZX-81. The best thing to do is to write to three firms which make a keyboard in the price range you can afford — most seem to cluster around the £20 and £30 mark — and select one of those. Redditch Electronics has been in the business of making ZX keyboards for at least as long as any other firm in the field so it may be worth approaching. Protos Computer Systems has produced a heavy-duty keyboard — see *Your Computer*, February — but this is very expensive at £64.95. The dK computer keyboard at £28.95 is supplied as a kit which is particularly easy to connect up to the ZX-81. Details on 03447-4731. dK 'tronics, on 0493-602453, produces a number of ZX add-ons, including a keyboard for £27.95. Fuller Micro Systems produces a keyboard unit which completely swallows the ZX-81 to produce a very neat enclosed unit. The keyboard kit is £18.95 or £24.95 built, plus £11.75 for the case. Details on 051-236 6109.

WORK AND PLAY

I am managing director of a small company which at present has an information shortage. This is due to the complexity of handling the details of a relatively modest volume of paperwork relating to purchase/sales ledger, stock control, cash flow, etc. We have consequently decided to investigate the advantages of using a computer system. We would require in the first instance the most economic system suitable for our needs to allow us to evaluate the full potential advantage with a view to expanding or renewing the entire system, if advisable, at a later date. Our preliminary investigations show we require at minimum a 16K or 32K unit, with disc storage, cassette, printer and either a built-in VDU or separate monitor. In addition, however, the equipment will be kept at home and so it would be suitable for personal use. That is, introducing my children to computing, playing games, using the screen for design and drafting purposes using a light-pen facility which in turn would mean high-resolution multicolour graphics. Having read any amount of available literature, I am confused. There is no immediate urgency, so if equipment is shortly to come on to the market which may prove more suitable than current items, I would be prepared to wait.

John E Adams,
Nottingham.

THE SIMPLE answer to all your needs would be an Apple II, but it is far from the cheapest machine. If you subtract the need for high-resolution graphics and the light-pen, there are many machines at the lower end of the domestic market which could provide much of what you require. Of greater importance than, say, the light-pen, though, is the availability of suitable software for your business. It may well be that there is a Pet program which you could use off the shelf. You certainly do not want to go to the lengths of computerising your business once, only to do it again in 18 months' time. Obtain some literature on the Apple II/ITT-2020, the 80-column Pet, and any computer around £300-£400 you find attractive. Make sure you enquire about suitable software before deciding.

U.S. SINCLAIR

While living in the U.S. earlier this year, I bought a ZX-80. I returned to the U.K. and contacted Sinclair Research, regarding conversion for U.K. use. I received a reply which stated that it was not possible to convert the unit. After several telephone calls to Sinclair, I was informed by the technical department that a conversion could be possible, but they were unable to help or advise me, and suggested that I wrote to a computer magazine! At present I have the ZX-80 plus connection leads to the TV, and the correct input voltage via a 220-110V transformer to the Sinclair transformer unit.

Colin Grimwood,
Tonbridge, Kent.

SORRY COLIN, but if Sinclair Research cannot help, neither can we. However, it seems that although the work required could be done, it would amount to a considerable degree of rebuilding, possibly more than the ZX-80 is worth. Why not buy a secondhand ZX-80 for around £35; or try and find an American TV; or the last alternative is to forget it and buy a ZX-81?

SPEAK TO ME

Would it be possible to add a voice to my ZX-81, similar to that of the Speak And Spell game available, or are there commercially-produced voice units? What can I buy to help me use the ZX-81 port?

William G Lockitt,
Rhyl,
Clwyd.

COMMERCIAL units, with vocabularies of around 144 words, are available which you may be able to adapt for the ZX-81. The best thing to do is to write to those advertising speech units and find out which of them could be adapted for the ZX-81. Units to produce music from the ZX-81 are available. A full range of hardware add-ons for the ZX-81 is available from the Buffer Micro Shop, Streatham High Road, London SW16. A programmable input/output controller based on the Z-80AP10 is available from Thurnall Electronics Ltd, telephone 061-775 4461. This allows you to use up to 16 programmable input/output lines, all TTL compatible. Control of the port can be carried out from within programs. R D Laboratories — 0920-84380 — provides a number of hardware interfaces for the ZX-81 which could prove useful.

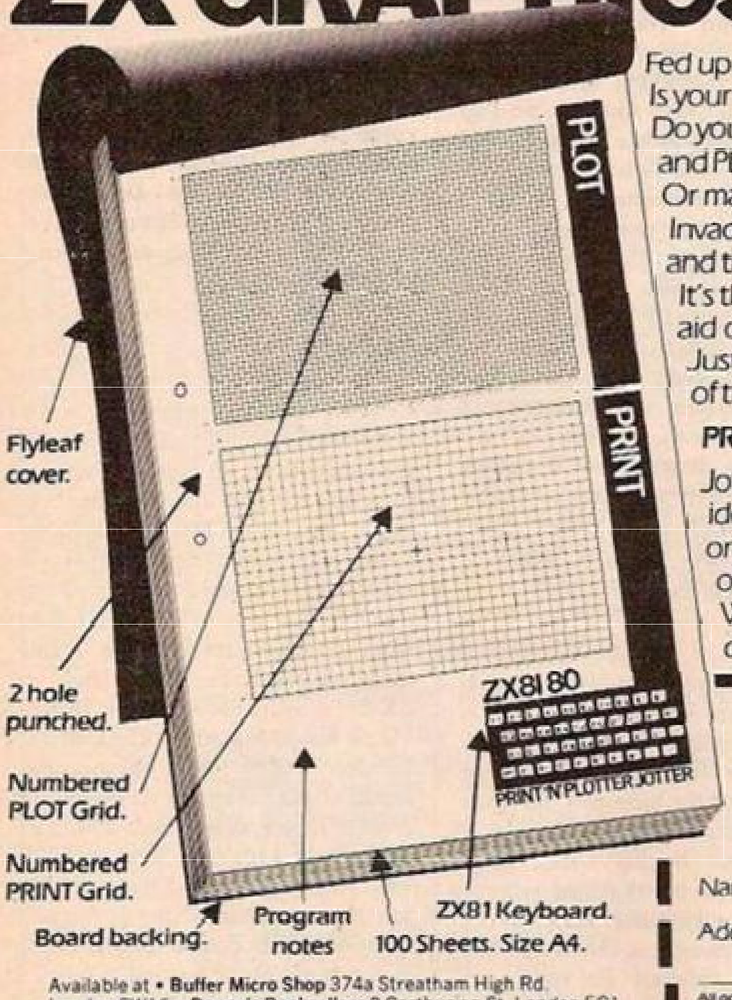
WHICH PRINTER?

I own a Vic-20 which I intend to expand to its full potential, as and when finances allow. I am interested in purchasing a printer and the ZX Printer, being the cheapest available, appeals most. Could you inform me if it is possible to connect the ZX printer to my Vic-20 and if this is very technical, is there someone who could supply the necessary goods ready assembled? As a hobbyist, I have limited resources, and technical expertise. Could you therefore inform me of the most suitable alternative if my suggestions are not feasible?

K Peat,
Chaddesden,
Derby.

NICK LAMBERT at Quicksilva tells us he has made an interface to connect the ZX printer to the Acorn Atom. There seems to be no reason, if this is true, why the same could not be done for the Vic-20. However, the unit will, of course, cost something, and the ZX printer output — although adequate for most purposes — in no way approaches the splendid quality of the Vic 1515 Printer. You can contact Quicksilva at 95 Upper Brownhill Road, Maybush, Southampton, Hampshire.

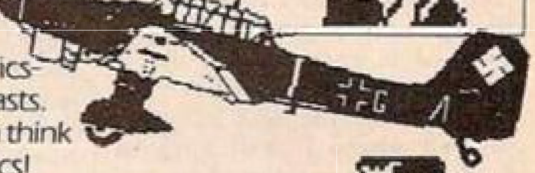
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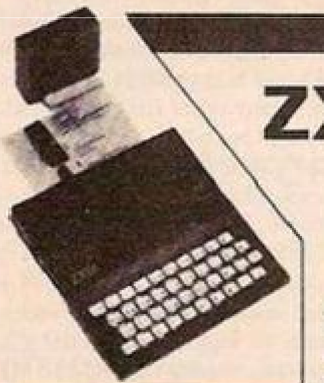
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FINGERTIPS

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

WE SEEM to receive a staggering number of letters from people who are 14 years old. A possible explanation for this unlikely phenomenon is that perhaps our correspondents like to pretend that they are child geniuses. For the youthful element in our readership, here is a note on statistical functions by Leon Goodfriend of Cardiff.

Most scientific calculators now have statistical capabilities; suitable programs are available for many micros, he writes. We are all aware of the simplest of all statistical functions — the average, or arithmetic mean to give it its proper name. It is found, of course, by dividing the sum of the available data by the number of data. We say that:

$$\text{Average} = \frac{\text{sum of data}}{\text{number of data}}$$

or

$$\bar{x} = \frac{\Sigma x}{n}$$

This introduces several pieces of notation:

$\bar{x}$ is the average value of x
Σx is the sum of the set of data
n is the number of data in the set

In general Σ, the Greek capital sigma, represents the sum of a set or series, and a straight line above a letter indicates the average or mean value.

The average is a useful and powerful tool, but it does not always tell us all we need to know. Look at the following sets of data:

x [17,15,18,18]   y[3,11,21,33]

$\bar{x}$ is 17, as is $\bar{y}$, but we can see that there is a much greater variation in the y set than in x. There is a way to measure the variation of a set. It is known as the standard deviation, and has the symbol σn — the letter σ is a lower-case sigma.

To find the standard deviation we need to know Σx,n and also another piece of information, Σx^2 — the sum of the squares of the values of x. The formula for standard deviation, like many others in statistics can take several forms and the following is one which is widely used:

$$\sigma n = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n}$$

Using this formula we can find that:
$x\sigma n$ (standard deviation of x set) = 1·2247
$y\sigma n$ = 11·225

There is another form of standard deviation which is preferable if we need to estimate deviation of a set without using all the data in that set. This second form of standard deviation has the symbol $\sigma n{-}1$ and is found as follows:

$$\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}$$

$x\sigma n{-}1$ = 1·4142
$y\sigma n{-}1$ = 12·9615

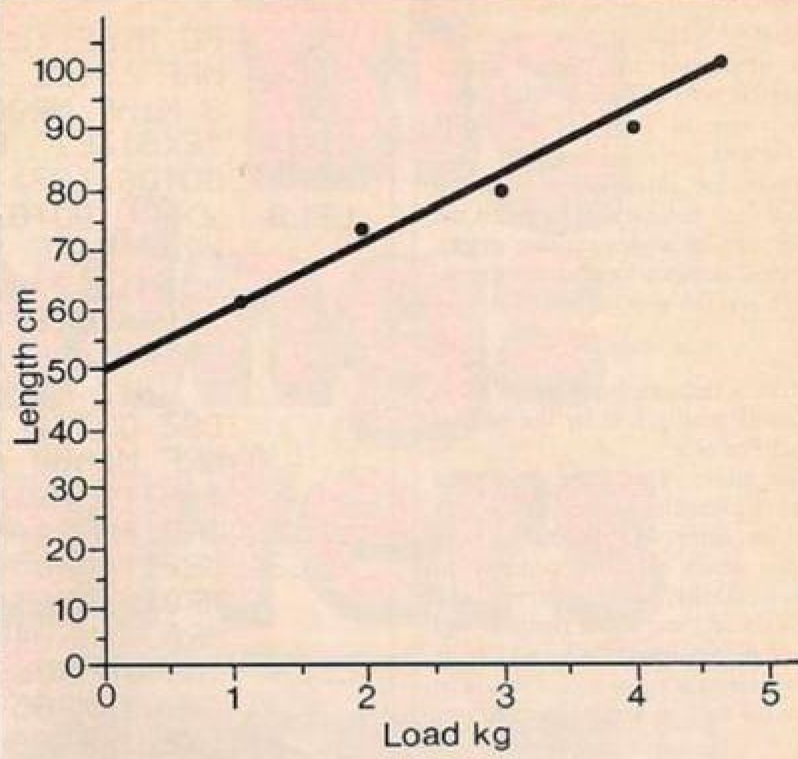
To distinguish between the two types of standard deviation, we call σn the population standard deviation and $\sigma n{-}1$ the sample standard deviation. The sample standard deviation is usually used when we are dealing with large sets of data and do not wish to enter them all into a calculator or computer. It allows for the fact that a small section from a set is less prone to variation than the whole set.

Standard deviation and averages can be applied to bar graphs and single sets of data, but we are often concerned with graphs which show how one commodity varies with another.

Look at the graph in figure 1. It shows how the length of a spring varies under different loads. The points corresponding to the results of the experiment are shown, along with the best straight line between them. Any straight-line graph can be expressed in the form

$$y = mx + c$$

Clearly, x and y specify the position of a point on the graph, but m and c require some explanation. The length of the spring with no load is 50cm. This is the point where the line of the graph crosses the y or vertical axis and is called the intercept. It is given the symbol "c", so "c" is the value of y when x=0.



Load (kg)	0	1	2	3	4	5
Length (cm)	49	60.1	72.2	79.3	89.4	100

Figure 1. Experimental data plotted as best straight line.

We can also measure the slope or gradient — shown by the symbol "m" — of the line. This can be done by drawing on the graph, but we will concern ourselves with a numerical method.

To find m and c we need the following information: $\Sigma x, \Sigma y, \Sigma x^2, \Sigma xy$,n. Σxy is the sum of the products of each pair of data i.e. for each pair of data, multiply x by y and add the answer to Σxy.

These equations will give us the best straight line through any set of points:

$$m = \frac{n\Sigma xy - \Sigma x \Sigma y}{n\Sigma x^2 - (\Sigma x)^2}$$

$$c = \frac{\Sigma y - m\Sigma x}{n}$$

For the graph in figure 1, m=10 and c=50, so we say that the equation of this line is

$$y = 10x + 50$$

Note that if the line slopes downwards from left to right then m will be negative.

Once we know m and c, only one of the values x and y needs to be known for us to calculate an estimate of the other. To indicate the estimated value of a number, we place a circumflex above it and the estimations for a straight line graph are:

$$\hat{y} = mx + c$$

$$\hat{x} = \frac{y - c}{m}$$

In the same way that we use standard deviation to measure variation in a single set, we have a means of measuring the closeness of fit of a set of points to a straight line. This is called the correlation coefficient and has the symbol "r". The correlation coefficient is given by the equation:

$$r = \frac{n\Sigma xy - \Sigma x \Sigma y}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2]\,[n\Sigma y^2 - (\Sigma y)^2]}}$$

and for figure 1, r=0·99809.

The value of r will always be between −1 and 1. A negative value simply indicates that the gradient of the line is negative. Values close to 1 and −1 indicate that the points are close to a straight line while values near zero indicate that the data probably do not represent a straight line graph.

If the result is exactly 1 or −1, then all the data lie precisely on a straight line. There is another test, known as the decision coefficient, which is simply the square of the correlation coefficient and has the

(continued on next page)

Figure 2. Non-linear curves.

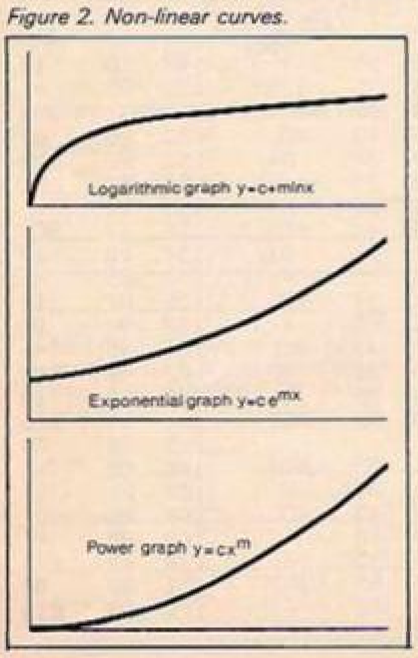


Table 1. Characteristics of various modes of regression analysers.

Type of Regression	Input x : y	For c	To estimate y: Input	To estimate y: For output	To estimate x: Input	To estimate x: For output
Linear	x : y	formula yields c	x	formula yields ŷ	y	formula yields x̂
Logarithmic	ln x : y	formula yields c	ln x	formula yields ŷ	y	find exponent of result
Exponential	x : ln y	find exponent of result	x	find exponent of result	ln y	formula yields x̂
Power	ln x : ln y	find exponent of result	ln x	find exponent of result	ln y	find exponent of result

(continued from previous page)

symbol r^2. This always returns a positive answer which tends to be closer to zero although values of r very close to 1 remain virtually unchanged.

There are three types of graph which may be analysed in much the same way as a straight-line graph. Figure 2 shows a logarithmic graph, which has the general equation

$$y = m \ln x + c$$

so rather than multiplying m by x, we must multiply m by the natural logarithm of x.

For those who have not used natural logarithms, they operate in just the same way as the log and antilog which are more common in lower maths, but whereas log operates to base 10, ln (natural log) operates to base "e", which is approximately equal to 2·7183. The term for natural antilog is exponent (e^x).

It is possible to form a whole new set of equations to analyse the regression of a logarithmic graph, but there is a much simpler method. Rather than performing our calculations using y and x, we can perform them on y and the natural logarithm of x (ln x). Thus we will obtain values of $\Sigma(\ln x)$, $\Sigma(\ln x)^2$, and $\Sigma(\ln x)y$ rather than Σx, Σx^2, and Σxy.

We can then apply all our usual formulae except that to estimate y we must again supply ln x rather than just x, and when calculating an estimate of ln x we actually receive an estimate of ln x so we must find the exponent of this number to obtain the correct estimation. Similar correction processes can be applied to exponential and power regression — see figure 2 — as table 1 shows.

Ivan Soh of Sheffield writes, this program runs on the Casio FX-602P programmable calculator. It solves an n x n determinant where n=2, 3 or 4. These are the most common sizes that are likely to be encountered by students in mathematics course.

The program can easily be adapted to run on the 502P by anyone who has experience of Casio programmable calculators.

```
       AC MinF (2)
LBL6   MRF "SIZE ?" HLT INT Min00 (15)
       3 MinF MR00-2=x>=0 GOTO8 (23)
LBL7   "E(SIZE)" PAUSE AC MinF (36)
       GOTO6 (37)
LBL8   x>=F  GOTO7 (40)
       MR00 MinF 1 Min18 (44)
       AC Min17 Min19 Min1F (48)
LBL0   1+10*(MR19+1)=Min17 (61)
LBL1   MR1F "a AR17 ?" HLT IND Min18 Min1f (73)
       1 M+17 M+18 (76)
       DSZ GOTO1 (78)
       MRF Min00 (80)
       1 M+19 MR19 x=f IND GOTO0 GOTO0 (87)
LBL2   MR01*MR04-MR03*MR02=GOTO5 (97)
LBL3   MR01*(MR05*MR09-MR08*MR06)- (110)
       MR02*(MR04*MR09-MR07*MR06)+ (122)
       MR03*(MR04*MR08-MR07*MR06)= GOTO5 (135)
LBL4   (MR01*MR06-MR02*MR05)*(MR11*MR16-MR12*MR15)+ (156)
       (MR03*MR05-MR01*MR07)*(MR10*MR16-MR12*MR14)+ (176)
       (MR01*MR08-MR04*MR05)*(MR10*MR15-MR11*MR14)+ (196)
       (MR02*MR07-MR03*MR06)*(MR09*MR16-MR12*MR13)+ (216)
       (MR04*MR06-MR02*MR08)*(MR09*MR15-MR11*MR13)+ (236)
       (MR03*MR08-MR04*MR07)*(MR09*MR14-MR10*MR13)= (256)
LBL5   Min1F (258)
       AC Min17 Min18 Min19 Min00 (263)
       MR1F "<DET>= AR1F" HLT (275)
       GOTO6 (276)

TOTAL STEPS: 276
REGISTER USED: 22 MAX. (R0-R4/R9/R16-R19;F;1F)
LABLES USED: 9(0-8)
```

Program 1 for Casio FX-602P to solve n x n determinant. The numbers in brackets at the end of each line are step numbers for checking purposes only.

When the program is called, "Size?" is displayed as a prompt for the user to input the order — that is, the size n of the n x n determinant of whose evaluation is required. If a decimal number is entered the calculator will evaluate a determinant whose size is the integer of the input value. Should an out-of-range number be input, the error message "E (size)" appears for about a second and then the "Size?" prompt is displayed again.

The first time the program is called, by pressing the program button under which the program is stored, n=0 by default. Subsequent evaluations will be performed for determinants of size $n_k = n_{k-1}$ by default.

Data is asked for in the usual notation a MN where M and N are integers which denote the position of the elements of the determinant. The user enters a 11, a 12 and so on, to evaluate the determinant.

The answer is displayed as <DET> = answer. It is stored in register 1F and hence can be displayed on pressing MR1F.

Note that when Goto n is pressed — where n is the integer-determinant size — the calculation is performed once again and the answer displayed. The elements are stored in the order in which they are input, beginning with register 01 upwards.

Five other register 00, 17 to 19 and F are utilised when calculations are performed but are cleared at the end of each evaluation.

However, errors have to be input manually. No provision has been made for software corrections of errors because it takes up much more unnecessary program space.

Note that I have optimised the program steps, and the utilisation of registers and labels.

A reader in Haywards Heath, Sussex, has written a program in response to our ladder problem a few months ago. ■

Program 2. Ladder and box.

000	76	LBL	025	10	10	050	04	04	075	00	00	100	38	SIN	125	95	=	149	10	10
001	11	A	026	00	0	051	99	PRT	076	75	-	101	30	TAN	126	35	1/X	150	95	=
002	02	2	027	32	X:T	052	43	RCL	077	43	RCL	102	94	+/-	127	65	X	151	42	STO
003	93	.	028	00	0	053	02	02	078	08	08	103	75	-	128	43	RCL	152	00	00
004	07	7	029	00	0	054	65	X	079	95	=	104	01	1	129	04	04	153	92	RTN
005	42	STO	030	00	0	055	01	1	080	42	STO	195	85	+	130	95	=	154	76	LBL
006	00	00	031	71	SBR	056	00	0	081	00	00	106	43	RCL	131	65	X	155	75	-
007	00	0	032	12	B	057	95	=	082	42	STO	107	00	00	132	43	RCL	156	43	RCL
008	42	STO	033	76	LBL	058	99	PRT	083	03	03	108	95	=	133	01	01	157	10	10
009	01	01	034	13	C	059	98	ADV	084	99	PRT	109	92	RTN	134	95	=	158	65	X
010	42	STO	035	71	SBR	060	91	R/S	085	71	SBR	110	76	LBL	135	94	+/-	159	01	1
011	02	02	036	75	-	061	76	LBL	086	65	X	111	85	+	136	85	+	160	00	0
012	42	STO	037	71	SBR	062	12	B	087	42	STO	112	43	RCL	137	43	RCL	161	95	=
013	03	03	038	85	+	063	43	RCL	088	05	05	113	02	02	138	02	02	162	42	STD
014	42	STO	039	71	SBR	064	00	00	089	99	PRT	114	75	-	139	95	=	163	10	10
015	04	04	040	12	B	065	42	STO	090	98	ADV	115	43	RCL	140	99	PRT	164	43	RCL
016	42	STO	041	43	RCL	066	02	02	091	92	RTN	116	03	03				165	08	08
017	05	05	042	04	04	067	99	PRT	092	76	LBL	117	95	=	141	98	ADV	166	55	÷
018	93	.	043	67	EQ	068	71	SBR	093	65	X	118	42	STO	142	65	X	167	01	1
019	01	1	044	14	D	069	65	X	094	43	RCL	119	01	01	143	43	RCL	168	00	0
020	42	STO	045	61	GTO	070	42	STO	095	00	00	120	43	RCL	144	10	10	169	95	=
021	08	08	046	13	C	071	04	04	096	55	÷	121	04	04	145	95	=	170	42	STD
022	01	1	047	76	LBL	072	99	PRT	097	03	3	122	75	-	146	59	INT	171	08	08
023	00	0	048	14	D	073	98	ADV	098	95	=	123	43	RCL	147	55	÷	172	92	RTN
024	42	STO	049	43	RCL	074	43	RCL	099	22	INV	124	05	05	148	43	RCL			

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VIC-20

MY PROGRAM is a simple version of Breakout using almost entirely Peeks and Pokes. Control is achieved using the Z key for left and the C key for right. First the computer draws a multicoloured wall using lines 15 to 70. A dot then appears at a random position along the bottom, the ball proceeds to bounce against the wall and the sides knocking out a brick every time it hits the wall.

You have a bat with which you must bounce the ball back up the screen to knock out another brick. If, by missing it, you let the ball reach the bottom row, you lose one of four chances. Eventually, if you do not lose all your lives you will break out of the top of the wall and win the game.

During my experiments with this program I discovered that it could be converted for use with joysticks by adding lines 13 to 470 shown at the end of the program. These extra lines allow you to use the joysticks with up for left, and down for right.

```
13 POKE 37139,0: POKE 37154,127
110 S = PEEK(37137)
140 IFS = 174THEND = D - 1:POKE 8145 + D,32
150 IFS = 182THEND = D + 1:POKE 8141 + D,32
470 POKE 37154,255:END
```

```
2 REM******BREAKOUT******
3 REM***BY DAVID JONES***
4 REM      11/1/82
5 PRINT"⊐■":POKE36879,9
6 PRINT" THIS IS THE GAME OF"
7 PRINT"       ■BREAKOUT■":PRINT:PRINT"THE Z-KEY MOVES LEFT":PRINT"THE C-KEY MOVE
S RIGHT"
8 PRINT:PRINT" HIT ANY KEY TO PLAY"
9 GETA$:IFA$=""THEN9
10 POKE36878,15:Y=20:DY=-1:C=4:GOSUB1000:PRINT"⊐"
15 FORJ=2TO7
20 FORI=0TO21
30 POKE38444+I+(J-2)*22,J
40 NEXTI:NEXTJ
50 FORI=0TO131
60 POKE7724+I,160
70 NEXTI
75 POKE7680+X+22*Y,81
80 POKE8142+D,98
90 POKE8143+D,98
100 POKE8144+D,98
110 S=PEEK(197)
140 IFS=33THEND=D-1:POKE8145+D,32
150 IFS=34THEND=D+1:POKE8141+D,32
160 IFD<0THEND=0
170 IFD>19THEND=19
180 POKE7680+X+22*Y,32
190 X=X+DX
200 IFX<1ORX>20THENDX=-DX:POKE36876,220
210 Y=Y+DY
220 IFY=22THEN300
225 IFY=0THEN400
230 IFPEEK(7658+X+22*Y)=160ANDDY=-1THENDY=1:POKE36876,230:POKE7658+X+22*Y,32
240 IFPEEK(7702+X+22*Y)=98THENDY=-1:POKE36876,240
250 POKE36876,0
260 GOTO75
300 POKE36874,140
310 FORI=0TO1000:NEXT
320 POKE36874,0
330 C=C-1
340 PRINT"■■■■■■■■■■■■■YOU HAVE ";C;"CHANCES             LEFT"
343 FORT=0TO1500:NEXT
345 FORK=0TO34:POKE7922+K,32:NEXT
350 IFC>0THEN:Y=20:DY=-1:GOSUB1000:GOTO75
355 GOTO460
400 FORU=0TO5
410 POKE36875,240
420 FORI=1TO90:NEXTI
430 POKE36875,0
440 NEXT
450 PRINT"■  CONGRATULATIONS        YOU'VE DONE IT"
```

(continued on next page)

(continued from previous page)

```
455 PRINT"[illegible]"
460 POKE36878,0
470 END
1000 X=INT(RND(1)*20)+1
1010 DX=INT(RND(1)*3)-1
1020 IFDX=0THEN1010
1030 RETURN
READY.
```

Mystery program

C E Lowe,
Ashton-Under-Lyne,
Greater Manchester.

ZX-81

THIS IS A short program which enables a Basic instruction to be translated into machine code without the use of an interpreter or assembly code. When you have finished entering it, simply press Run and all will be made clear.

```
LOWE MYSTERY PROGRAM

10 LET A = 16509
15 PRINTTAB 2; PEEK A * 256 + PEEK (A + 1);
20 LET L = PEEK (A + 2) + 256 * PEEK (A + 3) - 1
25 LET A = A + 3
30 FOR N = 1 TO L
35 IF PEEK (N + A ) <> 126 THEN GOTO 50
40 LET N = N + 5
45 GOTO 55
50 PRINT CHR$ (PEEK (N + A));
55 NEXT N
60 LET A = A + N + 1
65 IF A< 16914 THEN GOTO 15
70 LET A$ = "▛-9B25▛.885▛"
75 FOR N = 1 TO LEN A$
80 FOR J = 1 TO 50
85 NEXTJ
90 PRINT AT 15,12 + N; CHR$ (CODE A$ (N) + 144)
95 NEXT N

FOR ZX81 IN SLOW MODE
FOR ZX80 WITH 8K ROM. CHANGE THE FOLLOWING LINES.

65 IF A< 16924 THEN GOTO 15
80 PAUSE 60
85 POKE 16437,255
```

ROM tricks

Stephen Betts,
Eaton Bray,
Bedfordshire.

ZX-81

TONY POULTER'S noughts and crosses program, which appeared in the February issue, works perfectly in 1K but not if loaded into an extended ZX-81. This is because with more than 3.25K RAM connected, the display file is expanded by the ROM to fill the screen.

To trick the ROM into setting up a minimal display file, type either as a direct command, or as line 20:

POKE 16389,68

This command followed by the CLS in line 23 sets the system variable RAMtop to 17408 as it is when only 1K RAM is connected. As Tony Poulter says, if the length of his program is altered you should recalculate the variable P by using the expression

(PEEK 16396 + PEEK 16397*256) – 28

Electronic keep-fit

A J Capper,
Bristol.

ATOM

THIS PROGRAM incorporates the best features from a variety of sources to provide a disciplined approach to regaining fitness. One of the problems in our society today is that we do not get enough exercise, and computer addicts are worse than most. So it seems reasonable to use your micro to help you to get fit and stay fit.

The program uses the concept of pulse-regulated exercises, a concept pioneered in the U.S. and in the City Gymnasium in London. This is based on the idea that the maximum pulse rate that should be reached during exercise will vary with the age of the person doing the exercise, and for this stage one program, the relationship is:

Training Pulse Rate = (200 – Age) × 60%

This is the value given to the variable %P in line 3, and is the rate at which the bell will sound due to lines 94 and 95, so that you can check your pulse rate at the end of the session. As long as your pulse beats no faster than the TPR, you will not be overstraining your heart — but check it promptly as the pulse rate soon drops when you rest.

The basic routine starts with 10 repetitions of each exercise, followed by one minute of running on the spot. If you have no problem in doing this within your TPR, then you can increase the grade number up to a suggested maximum of grade 10.

An increase of one in the grade number increases the number of repetitions by one, and increases the time for running on the spot by 0.4 minutes, so that on the highest grade you will do 20 repetitions followed by running on the spot for five minutes — a total exercise time of around 25 minutes.

For those who do not feel fit enough to start at grade 0, which is the basic routine, the program allows you to have a handicap system with a negative grade number. There can be a maximum handicap with grade –9, which takes you down to one repetition of each exercise, followed by running on the spot for six seconds, which even the most unfit of us should be able to manage.

There is a considerable latitude in each exercise with regard to the degree of difficulty, or effort put it, so that each person can develop a routine which will fit their exact needs. The important point is to find a suitable starting routine which makes you work but which imposes no real strain, and then do that routine once each day for at least a week before moving up to the next grade.

Here is a description of the exercises. The first five are warm-up exercises, and it is really only on the last four that you start work.

Stand feet astride with arms at your side. One repetition of arm circling consists of lifting your arms slowly in a big circle, trying to brush your ears as you pass, and then bringing arms back to the starting point. Stretch as much as you can.

For side bends, stand feet astride with arms at your side. Bend first to the left and slide the left hand down the outside of the leg as far as you can go, then return to upright position. Do not bend forward or backward. Repeat on the right-hand side.

The trunk-and-knees bend involves your standing with feet together, weight on the front of the feet, legs slightly bent. Raise the left thigh up towards the chest as far as possible, and bend back down towards knee. Lower leg to floor and stand upright. Repeat on the right-hand side.

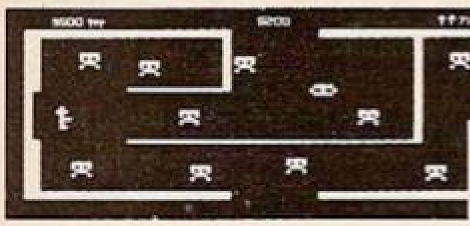
Stand with feet apart and both arms stretched out to the front for the head-and-arm twists. Leave the right arm pointing to the front and twist the left arm and trunk until it points directly behind you. Return to the start position and repeat with the right arm.

For the ankle reach stand with feet wide

(continued on page 75)

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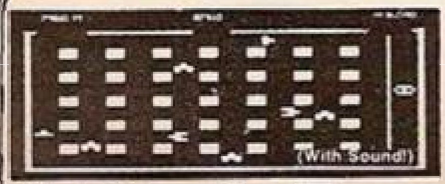
Several months ago the Kromorfkrom Empire invaded our planet and stole some of our newly developed and highly efficient "Krotnium" Star Cruiser fuel cells. Your mission is to infiltrate the Kromorfkrom Empire and pass yourself off as commanding officer of one of their fuel transport vessels. Once you have accomplished this, you must recover the fuel so that one of our Star Cruisers can warp in and take it back to our planet. You will be given a small shuttle armed with a powerful laser device. Eventually the aliens will uncover your plot and you will be forced to shoot and destroy them to protect the fuel. While you are defending at least one fuel cell, the aliens will be unable to use any of their high-powered battle equipment, for fear of accidently destroying a fuel cell. Once the aliens have reclaimed all of the fuel cells they will then be able to unleash their newest and most terrifying weapon ever: the Solar Waster!

GOBBLE MAN



Watch out behind you! As you hurry through the maze collecting modules you score points. But don't let the Gobblemen catch you. If you are crafty, sneek up behind them and neutralise them to gain extra points. Just keep a watch. When they attack you they come in fast. Just don't lose your nerve.

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Attack Force

Dodge the alien Ramships and fire missiles to destroy them before they get you. The alien Flagship uses his deadly laser bolt to transform a Ramship into another Flagship or into your ship's double. Look out! Destroy your double and you could destroy yourself.

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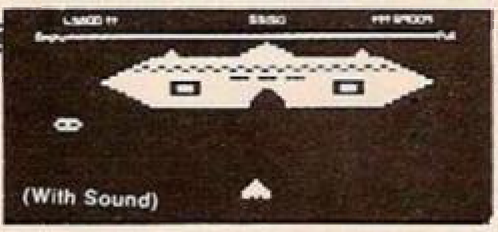
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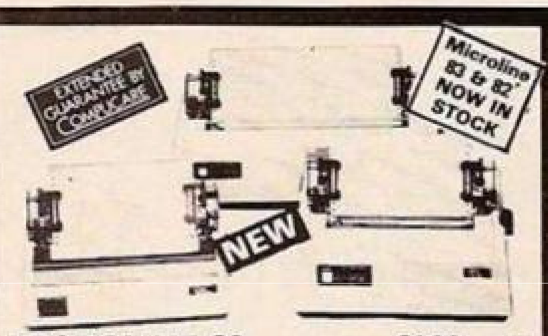
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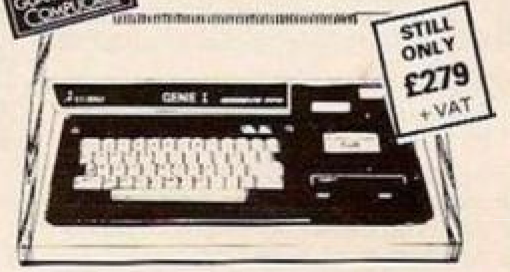
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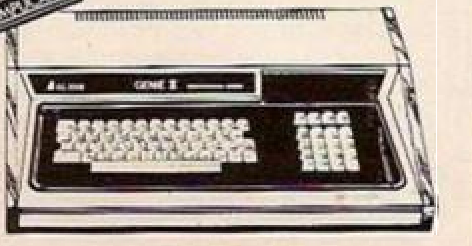


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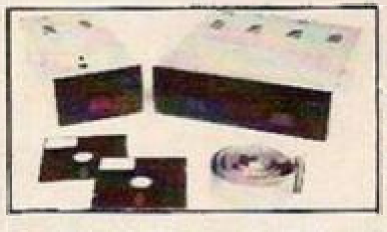


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(continued from page 72)

apart, both hands on left thigh. Slide hands down as far as possible towards the ankle. Return to upright position and repeat towards the right ankle.

At the start of these routines I advise you to do press-ups against a wall. Stand just further away than your outstretched fingertips and allow your body to fall towards the wall. Then push with your arms back to the vertical position. One repetition in this case equals two pushes.

If this causes no problems you can progress to doing the pushes against the top edge of a filing cabinet, which increases the work-rate somewhat. Again, one repetition equals two pushes. When you are used to this exercise you can progress to pushes against the edge of a table. This will require more effort, and one repetition equals one push.

For the seated knees-up, sit comfortably on a chair and grip the rear edge. Raise your knees as far as possible in the direction of your chest, then extend your legs forward and gradually lower them to the ground.

Overweight or very unfit persons are advised to treat the static jump with caution. Stand with feet together and arms by your side. One repetition consists of one jump in the air — the height will depend on how fit you are. At first you should be content just to lift both feet off the ground, but as you become fitter you can try to leap as high as you can.

In running on the spot, each pace is carefully timed, so that you do one pair of steps per second to start with, but they become very slightly faster as you progress through the grades.

```
1 P.$12;@=0
2 P."ISOTONICS STAGE ONE"''
3 IN."PLEASE ENTER AGE"A;%P=132-3*A/5
4 P.';IN."PLEASE ENTER GRADE NO."G
5 P.$12;F.W=1 TO 8
6 IF W=1 P."ARMS CIRCLING"
7 IF W=2 P."SIDE BENDS"
8 IF W=3 P."TRUNK/KNEES BEND"
9 IF W=4 P."HEAD/ARM TWISTS"
10 IF W=5 P."ANKLE REACH"
11 IF W=6 P."BODY PUSH"
12 IF W=7 P."SEATED KNEES UP"
13 IF W=8 P."STATIC JUMP"
14 F.Z=1 TO 13000;N.Z;P.$7
15 F.N=1 TO(10+G)
17 Y=12000-100*G
20 F.E=1 TO Y;N.E
30 P.$7
40 N.N
50 F.X=1 TO 5;P.$7;N.X
60 N.W
70 P.'"RUNNING ON THE SPOT"
75 Q=13000-G*250
80 F.Z=1 TO Q;N.Z
81 IF G<0;F.T=1 TO(120+12*G);G.83
82 F.T=1 TO (120+48*G)
83 V=710-5*G
85 F.R=1 TO V;N.R;P.$7
87 N.T
90 F.F=1 TO 25;P.$7;N.F;@=0
91 P.''"YOUR TRAINING PULSE RATE OF"'
   %(%P)" BEATS PER MINUTE"'
92 "WILL NOW SOUND"
94 %B=10100/%O;B=%(%B)
95 PF.P=1 TO B;N.;P.$7;G.P
100 E.
```

Read and Data

J D Tarrant,
Malvern Wells,
Worcestershire.

ATOM

THE LACK OF Read and Data on the Atom is a great disadvantage. My solution uses arrays to store Data and a variable to keep track of which element is to be Read next. The Data is read back to another variable by using the counter to define which element of the array is to be used next. This, I think, is a better way of achieving Read and Data than described in the manual because it uses much less memory.

Data can be input by using a For-Next loop and storing each entry in a separate element of the array. It can then be read back using this technique.

Restore can be achieved by setting the counter to zero. The computer can be instructed to go back, or indeed forward, to any number in the array at any point in the program by setting the counter to the element to be jumped to.

Strings can be used by this method by using the technique of dimensioning described by Derek Haslem, *Your Computer,* October 1981. Floating-point numbers can also be used by using fp arrays. Here is an example listing:

```
1 DIM AA(3); N=0
5 AA(0)=10; AA(1)=20; AA(2)=30;
  AA(3)=40; REM STORE DATA
10 REM PIECE OF PROGRAM
100 Q=AA(N); N=N+1; REM READ DATA:
  INCREMENT COUNTER
110 REM PIECE OF PROGRAM
200 IF N=4 THEN END: REM STOP IF NO
  DATA LEFT
210 PRINT Q'
230 GOTO 100
```

```
1 DIM AA(3); N=0
5 AA(0)=10;AA(1)=20;AA(2)=30;AA(3)=40;REM STORE DATA
10 REM PIECE OF PROGRAM
100 Q=AA(N);N=N+1;REM READ DATA;INCREMENT COUNTER
110 REM PIECE OF PROGRAM
200 IF N=4 THEN END;REM STOP IF NO DATA LEFT
210 PRINT Q'
230 GOTO 100
```

Lunar manoeuvre

S S Grewal,
Southall,
Middlesex.

ZX-81

THE INSTRUCTIONS to play this game are included in the listing with the user choosing how much fuel to burn. Just to prove how difficult my program is, I have to admit that I have never landed safely.

```
1 CLS
5 REM LUNAR LANDER
10 REM BY SSG 3-1-82
15 PRINT "INSTRUCTIONS? (Y/N)"
20 INPUT I$
```

(continued on next page)

(continued from previous page)

```
25 IF I$="N" THEN GOTO 95
30 REM INSTRUCTIONS
35 PRINT "WHILE FLYING A LOW ORBIT MAPPING"
40 PRINT "MISSION ON THE MOON, YOUR CRAFT"
45 PRINT "HAS HIT AN ASTEROID. YOU ARE "
50 PRINT "SAFE INSIDE YOUR EJECTED SPACE"
55 PRINT "CAPSULE WHEN YOU DISCOVER THAT"
60 PRINT "YOUR AUTOMATIC DESCENT COMPUTER"
65 PRINT "HAS FAILED. YOUR MAIN THRUST    "
70 PRINT "UNIT IS FALTERING BUT MAY GET "
75 PRINT "YOU DOWN SAFELY."
76 PRINT "TO SAVE THE CAPSULE YOU MUST "
77 PRINT "LAND AT LESS THAN 2FT/SEC. TO "
78 PRINT "SURVIVE YOU MUST LAND AT LESS "
79 PRINT "THAN 5FT/SEC. CAPSULE INSTRUM-"
80 PRINT "ENTATION IS OK AND WILL TELL "
85 PRINT "YOU WHERE YOU ARE. REMEMBER, "
90 PRINT "GRAVITY WILL ADD 5FT/SEC. TO "
91 PRINT "YOUR DESCENT."
92 PRINT
93 PRINT "GOOD LUCK"
94 PAUSE 1400
95 CLS
96 REM L=LIMIT OF BURN
100 LET L=INT(RND*(10)+25)
110 PRINT
120 PRINT "YOUR ENGINES ARE CAPABLE OF A "
125 PRINT "MAX. BURN OF"; L;"FT/SEC."
130 REM INITIALIZE DATA:T=TIME,H=HEIGHT,V=VELOCITY,F=FUEL LEFT
135 LET T=1
140 LET V=INT(RND*75)-75
145 LET H=INT(RND*300)+200
150 LET F=120
155 PRINT
160 PRINT "MANUAL DESCENT MODE ENGAGED"
165 PRINT
170 PRINT "TIME HEIGHT VELOCITY FUEL BURN"
175 PRINT "SEC. (FEET) (FT/SEC) LEFT"
180 PRINT TAB 1;T;TAB 7;H;TAB 15;V;TAB 22;F
185 INPUT B
190 IF B>L THEN B=L
195 IF F<=0 THEN LET B=0
200 IF B+100<=100 THEN LET B=0
210 LET F=F-B
215 REM B=BURN
220 LET T=T+1
225 LET V=V-5+B
230 LET H=H+V
235 LET E=RND*(12)
240 IF E<9 AND E>6 THEN GOSUB 500
245 REM VARIABLE "E" DETERMINES THRUST FAILURE
250 IF F<=0 THEN GOTO 290
255 IF H<=0 AND V+100=95 THEN GOTO 325
260 IF H<=0 AND V+100=98 THEN GOTO 310
265 IF H>0 THEN GOTO 180
270 PRINT "CONGRATULATIONS."
271 PRINT "YOU HAVE LANDED SAFELY"
275 PRINT "YOUR VELOCITY AT TOUCHDOWN WAS"
276 PRINT V;"FT/SEC."
280 PRINT "WITH ";F;"UNITS OF FUEL LEFT"
281 PAUSE 500
285 GOTO 360
290 PRINT "OUT OF FUEL"
295 IF H>0 THEN GOTO 180
300 GOTO 325
301 CLS
310 PRINT "YOU HAVE MADE A CONTROLLED "
311 PRINT "CRASH. YOU ARE ALIVE BUT THE"
312 PRINT "LANDER IS DAMAGED AND YOU ARE"
315 PRINT "***STRANDED***"
316 PAUSE 500
320 GOTO 275
321 CLS
325 PRINT "CRUNCH. YOU HAVE JUST BECOME "
330 PRINT "THE MOON'S NEWEST CRATER. YOUR"
331 PRINT "FLIGHT PAY WILL BE FORWARDED"
332 PRINT "TO YOUR NEXT OF KIN"
333 PAUSE 500
335 GOTO 275
340 PRINT
360 PRINT
365 PRINT "LIKE TO TRY AGAIN?(Y/N)"
370 INPUT X$
375 IF X$="Y" THEN RUN
380 IF X$<>"Y" AND X$<>"N" THEN GOTO 370
385 STOP
500 REM DERIVE LEVEL OF THRUST FAILURE
505 LET L=INT(L-(RND*(10)+1))
510 IF INT(L+100)<=100 THEN GOTO 530
515 PRINT "DETERIORATION IN MAIN THRUST"
516 PRINT "           UNIT           "
520 PRINT "YOUR MAX. BURN IS NOW";L; "FT/SEC."
525 RETURN
530 PRINT "YOUR THRUST UNITS HAVE FAILED "
531 PRINT "    COMPLETELY                  "
535 LET L=0
540 RETURN
```

Program conversion

Paul Kaufman,
Ely, Cambridgeshire.

UK 101

THIS SHORT BASIC routine enables a program resident in a Microtan system to be dumped to cassette in a format readable by the UK101 computer. To use the program, the following steps are performed: load into the Microtan the Basic program which you wish to convert. Reset from Basic and, using Tanbug's C, or copy command, move the previously-loaded program up about 4K in memory. First note where the program ended. All Basic programs will start from $401.

Re-enter Basic making sure that you protect your relocated program by replying to the question "Memory Size?". Enter the program form the listing and type Run. Then enter, in decimal, the start address of the relocated program and start your cassette recorder. The program will be dumped to tape in a format readable by the UK101. If you have specified the start address correctly you will obtain the message "Error — program not here".

Although both the Microtan and UK101 use the same 300-baud CUTS tape standard, the way the data is stored on tape differs. The Microtan uses a condensed method where each of Basic's keywords — For, Next, Gosub, etc. — is assigned a single byte code or tag.

However, the UK101 uses a less efficient method in that the entire keyword, letter by letter is stored on tape. This makes loading and saving to tape a much lengthier process, without Microtan's advantage of a high-speed 2,400-baud alternative.

What this program does then is to scan the designated text for the tags, look up the equivalent keyword and store it to tape. If an equivalent is not found, the character is directly stored to tape. The program knows when it has reached the end when it finds three consecutive nulls which designate the end of a Basic program.

```
10    REM** MICROTAN TO UK101 TAPE FORMAT CONVERTER
11    REM** PAUL B KAUFMAN JAN/82
12    REM**
14    REM**
15    REM**
20    DIMA$(69):POKE14,1:T$="":REM SET "CUTS" SPEED
30    FORI=1TO 69:READA$(I):NEXT:REM GET TAGS
40    PRINTCHR$(12):INPUT"Enter start address";AD:REM DECIMAL ADDRESS
50    IFPEEK(AD)<>0THENPRINT"Error-program not here"FORI=1TO200:NEXT:RUN
55    REM BEGIN SCAN OF PROGRAM
60    IFPEEK(AD)+PEEK(AD+1)+PEEK(AD+2)=0THENPOKE22,254:PRINTT$:GOTO999
70    PRINTT$:POKE22,254:PRINTT$:T$="":AD=AD+3
71    NM=PEEK(AD)+256*PEEK(AD+1):T$=T$+STR$(NM)+" "
72    AD=AD+2
80    IFPEEK(AD)=0THEN60
90    IFPEEK(AD)>127THENT$=T$+A$(PEEK(AD)-127):GOTO200
100   T$=T$+CHR$(PEEK(AD))
200   AD=AD+1
```

(continued on next page)

(continued from previous page)

```
210  GOTO80
999  PRINTT$:PRINT:PRINT:PRINT:PRINT"   PROGRAM COMPLETED":END
1000 REM DATA TABLE USED TO CONVERT TAGS INTO FULL WORDS
2000 DATAEND,FOR,NEXT,DATA,INPUT,DIM,READ,LET,GOTO,RUN,IF,RESTORE,
     GOSUB
2010 DATARETURN,REM,STOP,ON,NULL,WAIT,LOAD,SAVE,DEF,POKE,PRINT,CONT,
     LIST
2020 DATACLEAR,GET,NEW,TAB(,TO,FN,SPC(,THEN,NOT,STEP,+,-,*,/
     ,↑,AND,OR
2030 DATA>,=,<,SGN,INT,ABS,USR,FRE,POS,SQR,RND,LOG,EXP,COS,SIN,
     TAN,ATN,PEEK
2040 DATALEN,STR$,VAL,ASC,CHR$,LEFT$,RIGHT$,MID$,***
OK
```

Brahma

Paul Blythe,
Sheffield,
South Yorkshire.

ZX-80

THIS LOGIC problem is based on the project given by Brahma, the Hindu deity, to his disciples. The object of the game is to transfer a set of rings, of different sizes, from one pillar to another but at no time can a larger ring be on top of a smaller.

The program runs on a ZX-81 1K. However, typing errors or illegal moves when playing the game stretch the memory to its limits. There are five rings; ring 1 is the smallest. If, however, you have additional memory, you can have more rings by using the alternative lines shown at the end of the program where N is the number of rings. The solution for five rings is given below.

```
BRAHMA
10 DIM A(3,5)
11 FOR B=1 TO 5
12 LET A(1,B)=B
13 NEXT B
14 GOTO 160
20 PRINT "FROM"
21 INPUT C
50 FOR B=1 TO 5
60 IF A(C,B)<>0 THEN GOTO 80
70 NEXT B
75 GOTO 20
80 PRINT "TO"
81 INPUT D
82 IF C=D THEN GOTO 20
90 FOR E=1 TO 5
100 IF A(D,E)=0 THEN NEXT E
125 IF E=6 THEN GOTO 190
130 IF A(C,B)>A(D,E) THEN GOTO 20
140 LET A(D,E)=A(C,B)
150 CLS
155 LET A(C,B)=0
160 FOR F=1 TO 5
170 PRINT "    ";A(1,F);"    ";A(2,F);"    ";A(3,F)
180 GOTO 20
190 LET A(D,5)=A(C,B)
200 GOTO 150

10  DIM A (3,N)
11  FOR B = 1 TO N
50  FOR B = 1 TO N
90  FOR E = 1 TO N
125 IF E = N+1 THEN GOTO 190
160 FOR F = 1 TO N
190 LET A (D,N)= A(C,B)

SOLUTION

1-3, 1-2, 3-2, 1-3, 2-1, 2-3, 1-3, 1-2, 3-2, 3-1,
2-1, 3-2, 1-3, 1-2, 3-2, 1-3, 2-1, 2-3, 1-3, 2-1,
3-2, 3-1, 2-1, 2-3, 1-3, 1-2, 3-2, 1-3, 2-1, 2-3,
1-3
```

Alien arcade

Stuart Debuse,
Bognor Regis, Sussex.

VIC-20

THIS IS AN arcade game for one person, involving avoiding randomly-generated asteroids, while at the same time scoring points for hitting the occasional alien.

Z moves the spaceship to the left, and M moves it to the right. 200 points are awarded for hitting an alien; 50 points for hitting the side of the screen, and 100 points deducted for hitting an asteroid. The program takes full advantage of the Vic-20's colour and sound facilities.

```
1    PRINT"WHAT IS YOUR NAME?"
2    INPUT P$
3    PRINT"CLR"
4    PRINT"OFF YOU GO!";P$
5    FOR H=1TO1000:NEXTH
6    POKE 36879,8
7    H=0:S=0:Z=0
9    Q=50
10   A=7900:B=11:D=8164
20   FOR J=1TO24:PRINT:NEXT
25   FOR K=1TO600
30   POKE D +INT(32*RND(1)),46
35   R=INT(25*RND(1))
36   IF R=1 THEN 700
40   FOR J=1TO Q:NEXT
45   Q=Q-0.25
50   POKE A+B,32
55   PRINT
60   GET A$
70   IF A$=""THEN100
71   IF B=1 AND A$="M" THENH=H+1
72   IF B=21 AND A$="Z" THENH=H+1
80   IF B>1 AND A$="Z" THENB=B-1
90   IF B<21 AND A$="M" THEN B=B+1
100  POKE A+B,22
105  IF PEEK((A+B)+22)=46THEN 114
106  IF PEEK((A+B)+22)=42THEN 900
110  NEXTK
112  GOTO300
114  POKE36879,42
115  PRINT"CLR"
116  PRINT"(CTRL & WHT) DESTROYED BY ASTEROID!!"
200  POKE36877,220
201  S=S+1
210  FOR L=15TO 0STEP-1
220  POKE36878,L
230  FOR M=1TO100
240  NEXTM
250  NEXTL
260  POKE36877,0
270  POKE36878,0
275  POKE36879,8
280  GOTO30
300  PRINT "(CLR)":POKE36879,106
310  FOR R=1TO5:PRINT:NEXTR
313  Z=(H*50)-(S*100)+(X*200)
```

(continued on page 79)

NEW GAMES



THE NAUGHTY ONE

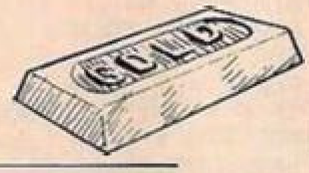
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Gamble for the clothes of your opponents, force the pawnbroker to auction some clothes (preferably from other players...), be given some saucy tasks or dole some out.
Build a massage parlour and bankrupt (or undress) your opponents, if they are unlucky...
A mini version of this game is now available on cassette. The maxi version on disk is much more expanded and contains in between other things 40 pubs and bars, 20 gambling houses, and also... .... no, we won't tell.
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THE SIGN OF HADRIN



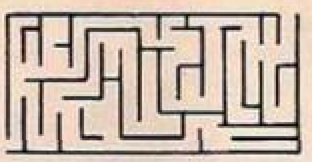
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GOLD



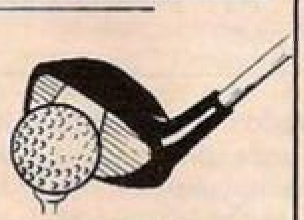
Find your way to more than forty rooms, collect the treasures and try to get out with them.
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A HILDERBAY GAME

THE MAZE GAME



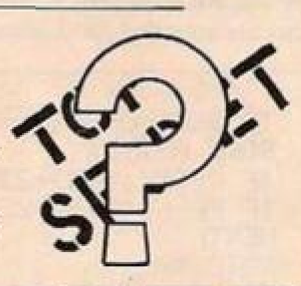
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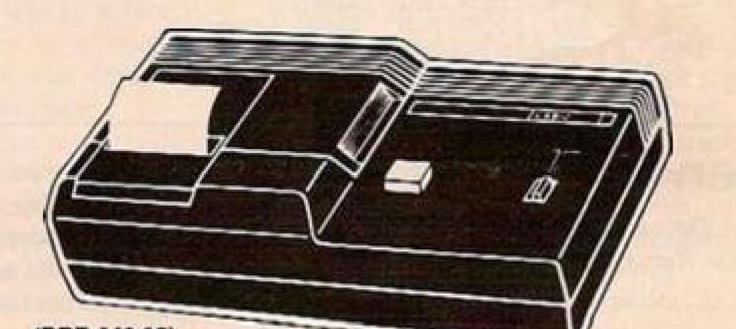
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(continued from page 77)

```
314  PRINT" YOU SCORED",Z
315  PRINT"POINTS",P$
320  PRINT"WELL DONE",P$
330  PRINT"YOU ONLY HIT";S
335  PRINT"ASTEROIDS THIS TIME"
336  PRINT
337  PRINT"YOU SCORED"
338  PRINT
339  PRINT"HITS";P$
340  PRINT
345  PRINT"YOU HIT ";X;" ALIENS"
350  PRINT"DO YOU WANT ANOTHER GO?"
360  PRINT"Y OR N?"
370  INPUTW$
380  IF W$="Y"THEN3
385  POKE36879,44
386  PRINT"CLR"
387  FOR U=1TO 11:PRINT:NEXTU
388  PRINT"(CTRL & YEL)O.K"
390  PRINT
395  PRINT"(CTRL & YEL)BYE FOR NOW";P$
400  END
700  FORP=1 TO 10
710  POKE D+INT(32*RND(1)),42
720  FOR J =1 TO Q:NEXTJ
730  POKE A+B,32
740  GOTO 55
900  POKE 36879,127
910  PRINT"CLR"
920  PRINT"(CTRL & BLK)GOOD HIT!"
930  POKE 36878,15
940  FOR L=1 TO 15
950  POKE36876,160
960  FOR M=1 TO 10:NEXT M
970  POKE36876,0
980  FOR M=1 TO 10:NEXT M
990  NEXT L
1000 POKE 36878,0
1010 X=X+1
1020 POKE 36879,8
1030 GOTO 30
```

Prime numbers

Jack Bettridge, Wallington, Surrey.

ZX-80

ANY PRIME NUMBER up to the arithmetical maximum of 32,767 can be identified with this program, which works fast if the computer is not asked to digest too many numbers at one time.

If there are hundreds of numbers between A and B, the screen will remain blank for some seconds and the Continue key may be subsequently needed to obtain additional pages.

Lines 90 to 140 are required just in case 1, 2, and 3 are included in the A to B range. Anyone willing to ignore the technicality that these first three numbers are primes can save six lines of program. It is obviously a waste of time counting any even number after 2, so lines 150 and 220 ensure only odd numbers are considered. Each odd number within the range is progressively divided and repeatedly tested for a remainder or zero by lines 180 to 210. Line 250 is necessary because the ZX-80 has no Step facility.

```
10   PRINT "PRIME NUMBERS FROM?"
20   INPUT A
30   PRINT "TO?"
40   INPUT B
50   CLS
60   PRINT "ALL PRIME NUMBERS BETWEEN" ;A
70   PRINT "AND ";B;":"
80   PRINT
90   LET C=A
100  FOR Y=1 TO 3
110  IF NOT C=Y THEN GOTO 140
120  PRINT Y;"  ";
130  LET C=C+1
140  NEXT Y
150  IF 2*(A/2)=A THEN LET A=A+1
160  FOR Y=A TO B
170  LET Q=3
180  LET R=Y/Q
190  LET P=Y-R*Q
200  IF P=Q THEN GOTO 250
210  IF Q>R THEN GOTO 240
220  LET Q=Q+2
230  GOTO 180
240  PRINT Y;"  ";
250  LET Y=Y+1
260  NEXT Y
```

Faster slow mode

G W Hewitt, Edinburgh.

ZX-81

IF, LIKE ME, you like to type in programs in slow mode, you will have found that it can be annoying when adding lines to a long program to have to wait while the computer writes the entire screen every time. It is especially bad if the line is a long Print or Rem line.

This small program can be temporarily stored near the start of the program using a few spare lines. When one has a screen full of lines, type Goto (first program line). Answer the prompt with the last line you have entered and it will return you to that line with an empty screen below. It also Pokes the listing-system variable to ensure that every relist after that will return to your chosen line.

(continued on next page)

```
2 CLS
3 PRINT "TYPE LINE NO"
4 INPUT XXX
5 POKE 16419, XXX - INT(XXX/256)*256
6 POKE 16420, INT (XXX/256)
7 LIST XXX
8 STOP
```

(continued from previous page)

Top drawer

A J Bissex,
Radstock,
Avon.

GENIE

THE PROGRAM IS operated by means of five keys. The user can draw whatever he wants with this simple program for the Video Genie. The keys are as folows:

1: Left
2: Right
3: Down
4: Up
5: Clear the screen to start again

The drawing will start in the middle of the screen or at the points specified in line 20. You can alter these points as you wish. By adding a line 35, the user will be able to move the dot around the screen without leaving a trail. The line 35 would be as follows:

35 RESET (XX,YY)

```
10  CLS
20  XX=62:YY=24:SET(XX,YY)
30  A$ = INKEY$ : IF A$ ="" THEN 30
40  IF A$ = "1" THEN 100
50  IF A$ = "2" THEN 110
60  IF A$ = "3" THEN 120
70  IF A$ = "4" THEN 130
80  IF A$ <> "0" THEN 30
90  CLS : GOTO 10
100 XX=XX+1
105 GOTO 140
110 XX=XX-1
115 GOTO 140
120 YY=YY+1
125 GOTO 140
130 YY=YY-1
140 IF XX<0 OR XX>127 OR YY<0 OR YY>47 THEN 30
150 GOTO 20
```

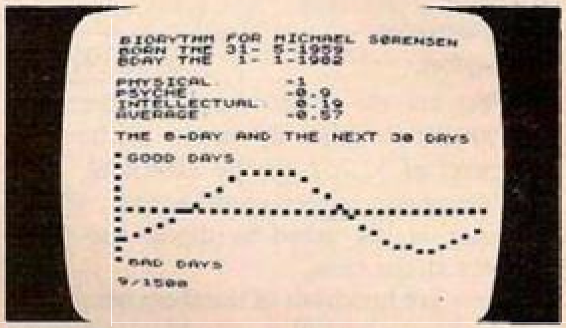
Biorhythms

Michael Sórensen,
Hvidovre,
Denmark.

ZX-81

YOUR BIORHYTHM tells you how you should feel. It is the average of the physical, the psyche and the intellectual rhythms. This program tells you the values of the three rhythms and their average on a certain day, and then goes on to print the biorhythm curve for the next 30 days.

The many Rem statements make the program self-explanatory. The three rhythms are calculated as soon as you have entered your date of birth. You can omit the spaces in the program if you like — and the Rem statements, too. The program fills about 4.5K but it can be reduced to less than 3K by these omissions.




```
10    REM ************************
20    REM *                      *
30    REM *  BIORYTHM PROGRAM    *
40    REM *  A PROGRAM BY:       *
50    REM *  MICHAEL SORENSEN    *
60    REM *  FOR ZX-81 WITH 16K  *
70    REM *                      *
80    REM ************************
90    REM INPUT
100   PRINT AT 0,0;"BIORYTHM FOR"
110   PRINTAT 20,0;"WRITE THE NAME"
120   PRINT AT 21,0;"AND PRESS *NEWLINE*"
130   INPUT A$
140   PRINT AT 0,13;A$
150   PRINT AT 1,0;"BORN THE"
160   PRINT AT 20,10;"BIRTHDAY"
170   INPUT FD
180   PRINT AT 1,9+(FD<10);FD;"-"
190   PRINT AT 20,10;"MONTH OF BIRTH"
200   INPUT FM
210   PRINT AT 1,12+(FM<10);FM;"-"
220   PRINT AT 20,10;"YEAR OF BIRTH"
230   INPUT FY
240   PRINT AT 1,15;FY
250   PRINT AT 2,0;"BDAY THE"
260   PRINT AT 20,10;"BIORYTHM DAY"
270   INPUT BD
280   PRINT AT 2,9+(BD<10);BD;"-"
290   PRINT AT 20,19;"MONTH"
300   INPUT BM
310   PRINT AT 2,12+(BM<10);BM;"-"
320   PRINT AT 20,19;"YEAR"
330   INPUT BY
340   PRINT AT 2,15;BY
345   REM PRINT 23 SPACES
350   PRINT AT 20,0;
      "                       "
355   REM PRINT 23 SPACES
360   PRINT AT 21,0;
      "                       "
400   LET S=0
500   REM CALCULATE THE NUMBER OF DAYS IN THE REST OF THE YEAR
510   LET D=FD
520   LET M=FM
530   LET Y=FY
550   GOSUB 2000
560   LET AD=-X
600   REM CALCULATE THE NUMBER OF INTERCALARY DAYS
610   FOR Z=FY TO BY
620   IF Z/4-INT (Z/4)=0 AND Z/100-INT (Z/100)<>0 AND FY <> BY
      THEN LET S=S+1
630   NEXT Z
640   REM CALCULATE THE NUMBER OF DAYS FROM THE BIRTH TO THE
      BIORYTHM YEAR STARTS
650   LET AD=AD+S+365* (BY-FY)
700   REM CALCULATE THE NUMBER OF DAYS IN THE BIORYTHM YEAR
710   LET D=BD
720   LET M=BM
730   LET Y=BY
750   GOSUB 2000
760   LET AD=AD+X+( M > 2 AND Y/4 -INT (Y/4)=0 AND Y/100-INT
      (Y/100) <>0)
800   REM CALCULATE THE BIORYTHM
810   GOSUB 2500
820   REM TRANSCRIBE THE BIORYTHM
830   PRINT AT 4,0;"PHYSICAL:"; TAB (15-(INT (99*A+.5) <0));
      INT (100*A+.5)/100
840   PRINT "PSYCHE:"; TAB (15-(INT (99*B+.5) <0)); INT
      (100*B+.5)/100
850   PRINT "INTELLECTUAL:"; TAB (15-(INT (99*C+.5) <0)); INT
      (100*C+.5)/100
860   PRINT "AVERAGE":"; TAB (15-(INT (99*D+.5) <0)); INT
      (100*D+.5)/100
870   PRINT
880   REM PRINT A SYSTEM OF CO-ORDINATES
890   PRINT AT 11,1;"GOOD DAYS"
900   PRINT AT 21,1;"BAD DAYS"
910   PRINT AT 9,0;"THE B-DAY AND THE";"NEXT 30 DAYS"
920   FOR P=1 TO 21 STEP 2
930   PLOT 0,P
940   NEXT P
950   FOR P=0 TO 63 STEP 2
960   PLOT P,11
970   NEXT P
1000  REM PRINT THE CURVE
1010  FOR G=AD TO AD+30
1020  GOSUB 2520
1030  PLOT 2*(G-AD)+1, INT (10*D+.5)+11
1040  NEXT G
1400  REM THE END
1500  STOP
2000  REM THE NUMBER OF DAYS FROM THE 1/1
2010  LET X=D
2020  IF M=2 THEN LET X= 31+X
2030  IF M=3 THEN LET X= 59+X
2040  IF M=4 THEN LET X= 90+X
2050  IF M=5 THEN LET X=120+X
2060  IF M=6 THEN LET X=151+X
2070  IF M=7 THEN LET X=181+X
2080  IF M=8 THEN LET X=213+X
2090  IF M=9 THEN LET X=242+X
2100  IF M=10THEN LET X=273+X
2110  IF M=11THEN LET X=303+X
2120  IF M=12THEN LET X=334+X
2200  RETURN
2500  REM CALCULATE THE BIORYTHM
2510  LET G=AD
2520  LET A=SIN (2*PI*G/23)
2530  LET B=SIN (2*PI*G/28)
2540  LET C=SIN (2*PI*G/33)
2550  REM CALCULATE THE AVERAGE
2560  LET D=(A+B+C)/3
2600  RETURN
2700  STOP
9700  REM SET THE RECORDER TO RECORDING AND PRESS: RUN 9800
9800  SAVE "BIORYTHM"
9900  RUN
```

Double height

Brian Syme,
Strom,
Whiteness,
Shetland.

ZX-81

THIS PROGRAM has been written to run on the ZX-81 with 16K and printer produces a double-height character set on the printer. RAMtop must be set to 30720 by

POKE 16389,120. NEW

The program works by creating two new character sets, one for the upper half of each character and one for the lower. When printing a line, text is Poked into the printer buffer and then printed using the modified ROM routine.

Before loading, execute the following commands:

POKE 16389,120

POKE 16388,0
NEW

To print a line, use the routine at line 9200, for example:

10 LET P$ = "TEXT TO BE PRINTED"
20 GOSUB 9200

Lines 10 to 65 of the main program load the new character set; lines 9000 to 9120 are the copy routine and lines 9200 to 9310 contain the LPrint routine.

```
10 REM (C) 1982 BRIAN SYME
11 DIM E$(32)
12 LET M=PEEK 16389*256
15 FOR X=0 TO 63
17 REM THIS SECTION LOADS THE NEW CHARACTER SET ABOVE RAMTOP
20 FOR C=0 TO 3 .
22 POKE 2*C+X*8+M,PEEK (7680+X*8+C)
24 POKE 1+2*C+X*8+M,PEEK (7680+X*8+C)
26 POKE 512+2*C+X*8+M,PEEK (7680+X*8+C+4)
28 POKE 513+C*2+X*8+M,PEEK (7680+X*8+C+4)
30 NEXT C
40 NEXT X
50 FOR I=0 TO 112
55 POKE 31744+I,PEEK (2161+I)
60 NEXT I
65 POKE 31857,201
9000 REM DOUBLE HEIGHT SCREEN COPY
9020 LET UF=PEEK 16396+PEEK 16397*256
9030 FOR U=0 TO 21
9040 FOR O=1 TO 32
9050 POKE 16443+O,PEEK (UF+U*33+O).
9060 NEXT O
9070 POKE 31800,PEEK 16389/2
9080 LET UZ=USR 31744
9090 POKE 31800,PEEK 31800+1
9100 LET UZ=USR 31744
9110 NEXT U
9120 RETURN
9200 REM DOUBLE HEIGHT PRINT ROUTINE
9210 LET Z=INT((LEN P$-1)/32)*32
9220 LET P$=P$+E$( TO 32-(LEN P$-Z))
9230 FOR X=0 TO INT (LEN P$/32)-1
9240 FOR Y=1 TO 32
9250 POKE 16443+Y,CODE P$(Y+X*32)
9255 NEXT Y
9260 POKE 31800, PEEK 16389/2
9270 LET XX=USR 31744
9280 POKE 31800,PEEK 31800+1
9290 LET XX=USR 31744
9300 NEXT X
9305 LET P$=""
9310 RETURN

To copy the screen use

GOSUB 9000
```

Satellite plot

B T Jeeves,
Sheffield,
South Yorkshire.

ZX-81

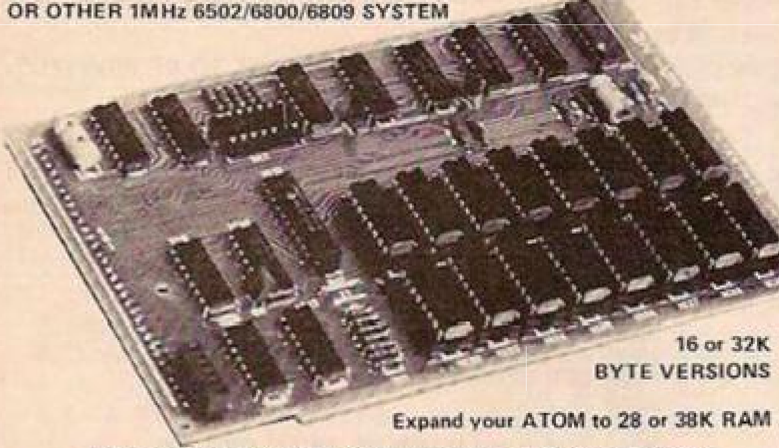
I WROTE THIS program to determine satellite parameters. When run, the program requests you to select which input your require, height or velocity. This is followed by a request for the particular figures in miles, or miles per second. The program then prints out the satellite data including the orbital period. Not earth-shaking, but a change from the well-known "Invaders From Galactic Space Laser Blasters" genre.

```
5 REM "SATELLITES BY TERRY JEEVES"
10 PRINT "TO DETERMINE SATELLITE VEOLICTY, HEIGHT
   AND PERIOD IN A CIRCULAR ORBIT"
15 PRINT
20 PRINT
25 PRINT "TO SOLVE ORBITAL ELEMENTS, CHOOSE
   1 OR 2 AND N/L"
30 PRINT
35 PRINT "FOR A GIVEN HEIGHT......1"
40 PRINT "FOR A GIVEN VEOLICTY....2"
45 INPUT A
50 IF A=1 THEN GOTO 70
55 IF A=2 THEN GOTO 100
60 IF A<>1 OR A<>2 THEN CLS
65 IF A<>1 OR A<>2 THEN GOTO 10
70 CLS
75 PRINT "INPUT HEIGHT IN MILES"
80 INPUT H
85 LET V=(INT((SQR((144*10**10)/(3960+H)))*36))/100
90 PRINT "ORBITAL VELOCITY AT ";H;" MILES IS ";V;" MILES/SEC"
95 GOTO 125
100 CLS
105 PRINT "INPUT VELOCITY IN MILES/SEC"
110 INPUT V
115 LET H=(INT(100*((144*10**10)/((3600*V)**2)-3960)))/100
120 PRINT "AT A VELOCITY OF ";V;" MILES/SEC, ORBITAL HEIGHT WILL BE
";H;"MILES"
125 PRINT
130 PRINT
135 LET P=(INT(100*(2*PI(3960+H)/(60*V))))/100
140 PRINT "ORBITAL PERIOD WILL BE ";P;" MINUTES"
```

■

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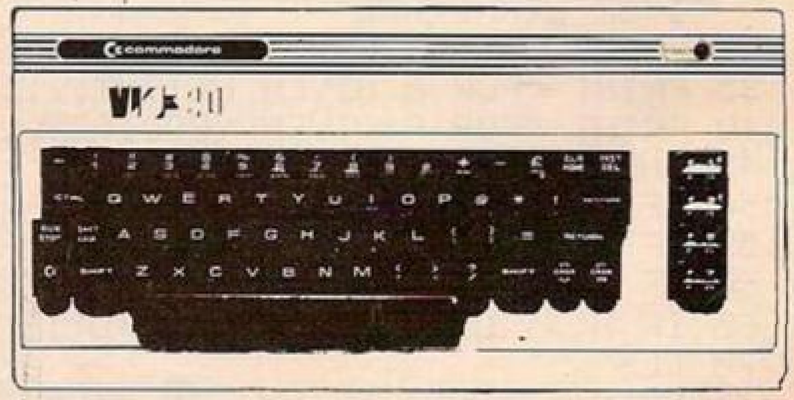
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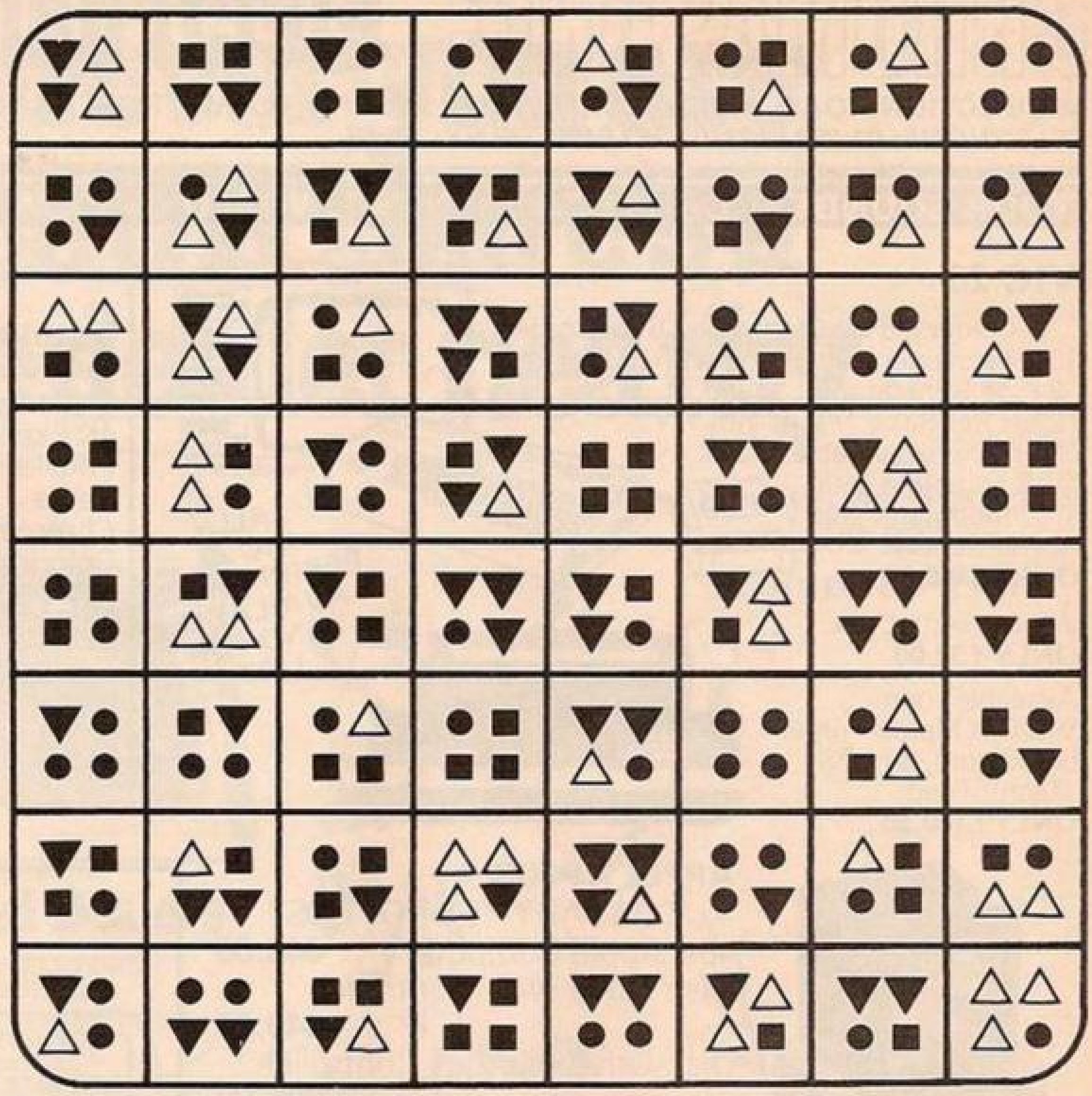
Klingon death

BY ANTHONY ROBERTS

THE KLINGONS' treasure is contained in a hollowed asteroid bristling with automatic defence mechanisms. One button on this control panel will defuse them all — it is your problem to find which. The other buttons will self-destruct, so a mistake will be fatal.

By a massive computer search through the Klingon central systems, find the key: each button has four symbols and it is possible to press every button but one in a closed-loop sequence in which each button is identical in all but one symbol with the previous button pressed, and in which no button is pressed twice until the first button is reached again.

The one button not in the sequence is the defuse button. What does it look like?



A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in April. The name of the winner, the solution, and a competition report will be published in the June issue of *Your Computer*.

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

Competition results

THERE WERE more than 500 entries for the BBC Micro crossword competition in February. Most found the correct solution without too much difficulty and suggested a plethora of alternative names for the BBC Microcomputer. After much deliberation, we declared J Parkinson of 16 Newquay Avenue, Reddish, Stockport, Cheshire, SK5 7BQ, as the winner. A BBC Micro is on its way.

His suggestion for a better name for the BBC Micro was "Zaphod — a beeb-box with two brains". Any who does not understand the significance of that sentence is advised to read Douglas Adams' *Hitch-hiker's Guide to the Galaxy*.

Geoff Kayum of Guildford, gave vent to his feelings with "Nessy II — Everyone's seen a photo, but does it exist?" while Steve Saddington of Havant, Hampshire, took a leaf out of a popular TV series with his "Basil — B-cos sum ULA chips R Fawlty".

The Troll Plague competition published in February also drew a large response with entries coming from as far afield as Norway, Denmark and Greece. The solution, as most of you discovered, was 17 copper coins. A variety of programs were sent in, including a mammoth one from J Blackman of Norbury, London. The winning solution was provided by K Moseley of 30 The Uplands, Harpenden, Hertfordshire, AL5 2NZ. ■

K Moseley's Troll Plague solution.

```
10 I=1
20 C=I:K=1:B=0
30 L=C:C=C+B:B=B+L
40 IF B+C<3 THEN GOTO 160
50 B=B-2
60 IF B>1 THEN GOTO 50
70 IF B=0 AND K<5 THEN GOTO 160
80 IF K<75 THEN GOTO 100
90 IF C<=2 THEN PRINT I:END
95 GOTO 160
100 K=K+1:IF K=6 THEN GOTO 160
110 C=C+B:B=0
120 B=B+1
130 C=C-2
140 IF C<1 THEN GOTO 30
150 GOTO 120
160 I=I+1:GOTO 10
```

The February crossword solution.



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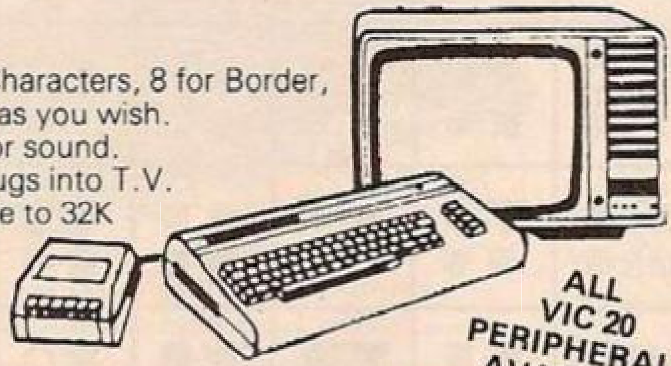
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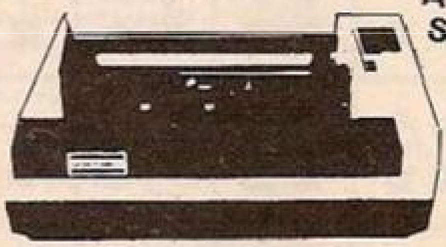
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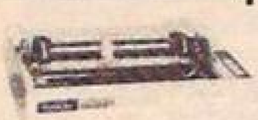
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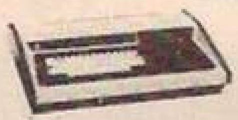
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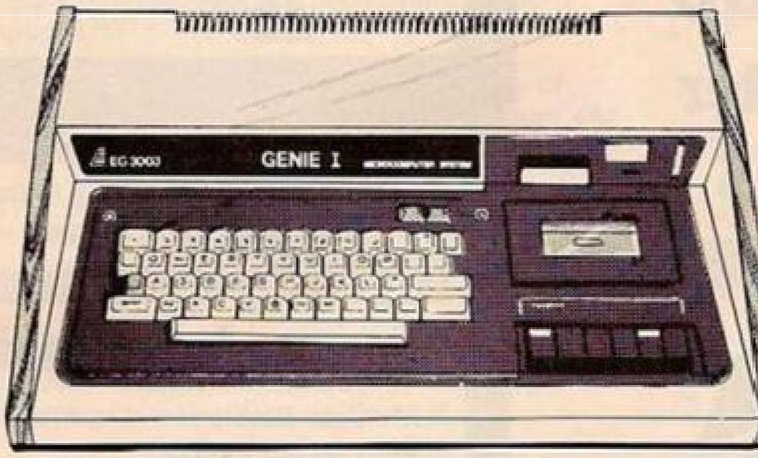
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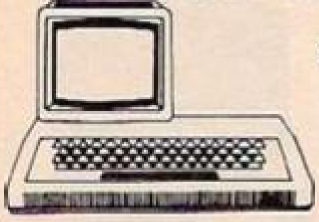
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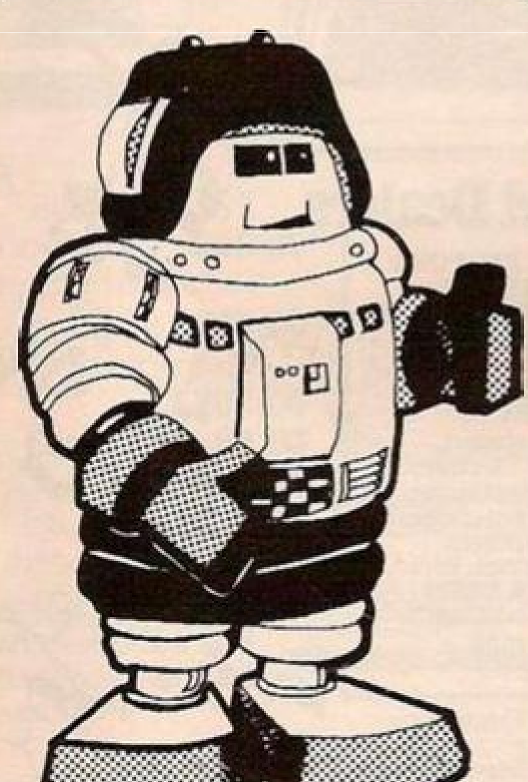
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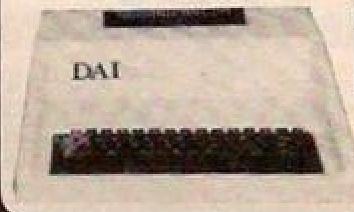
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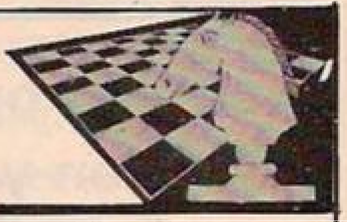
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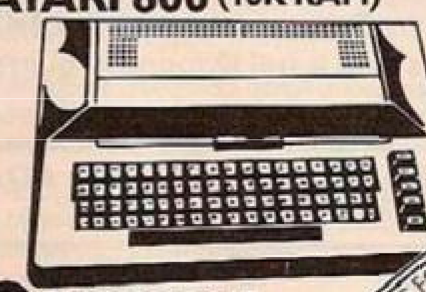
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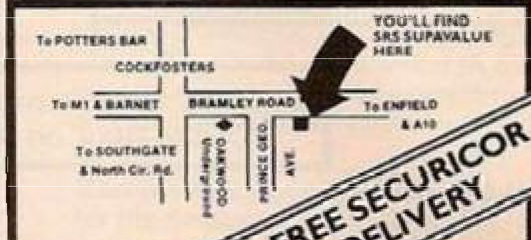
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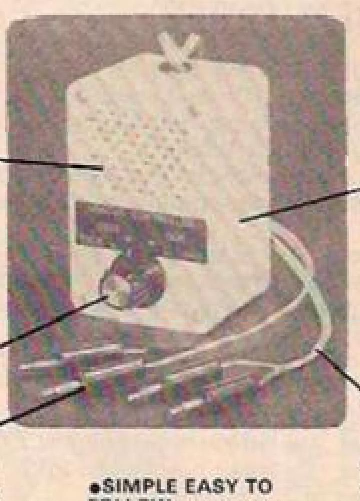
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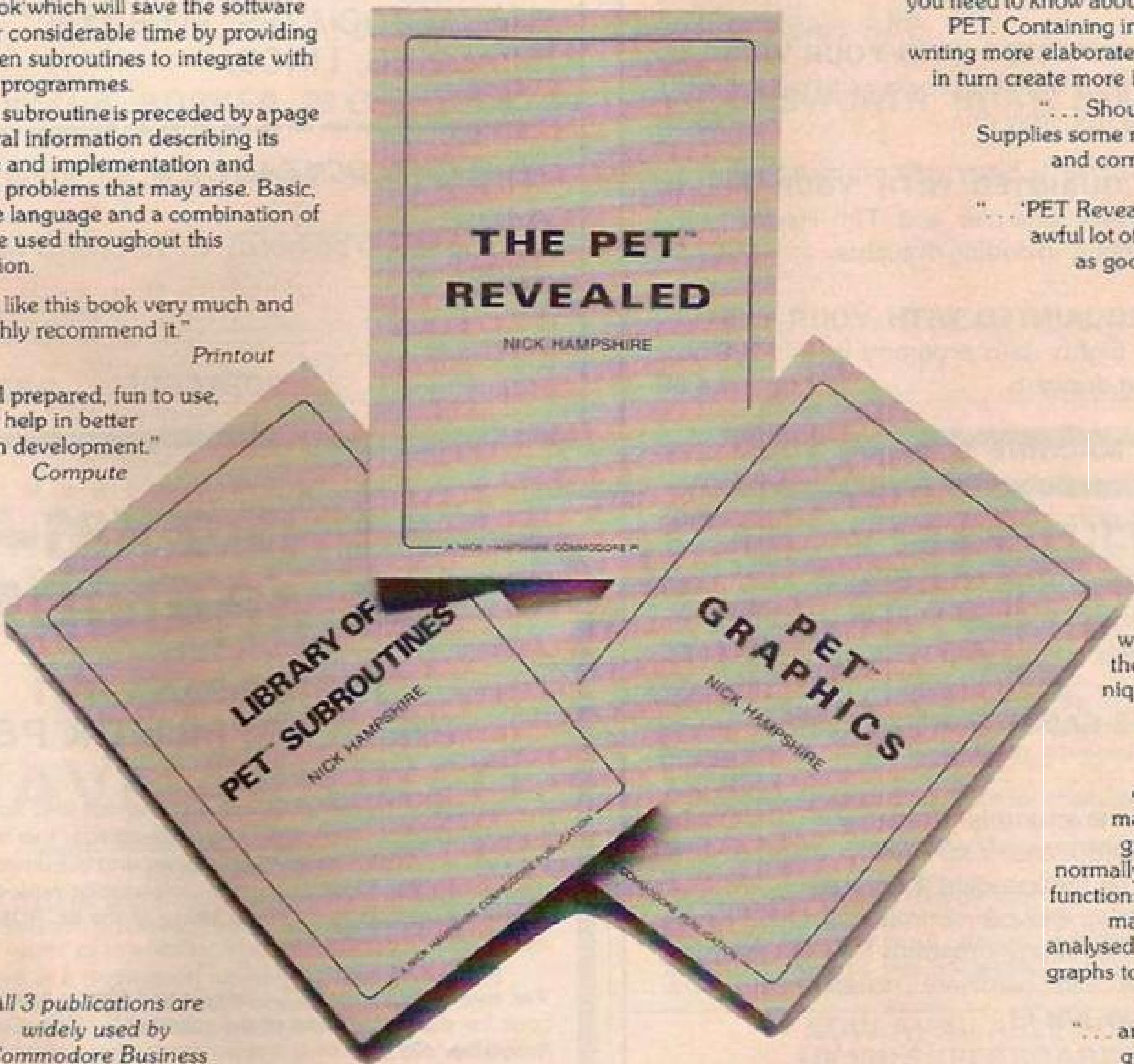
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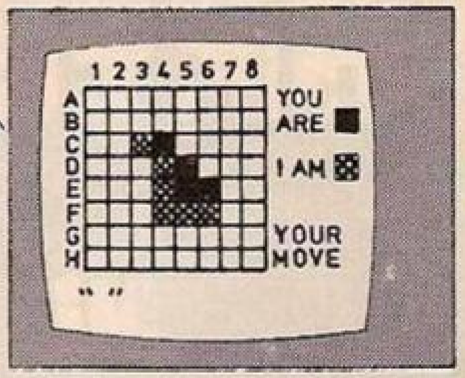
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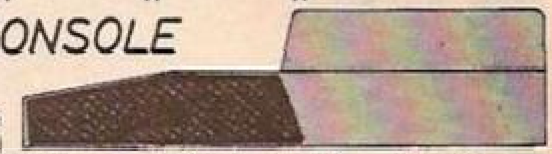
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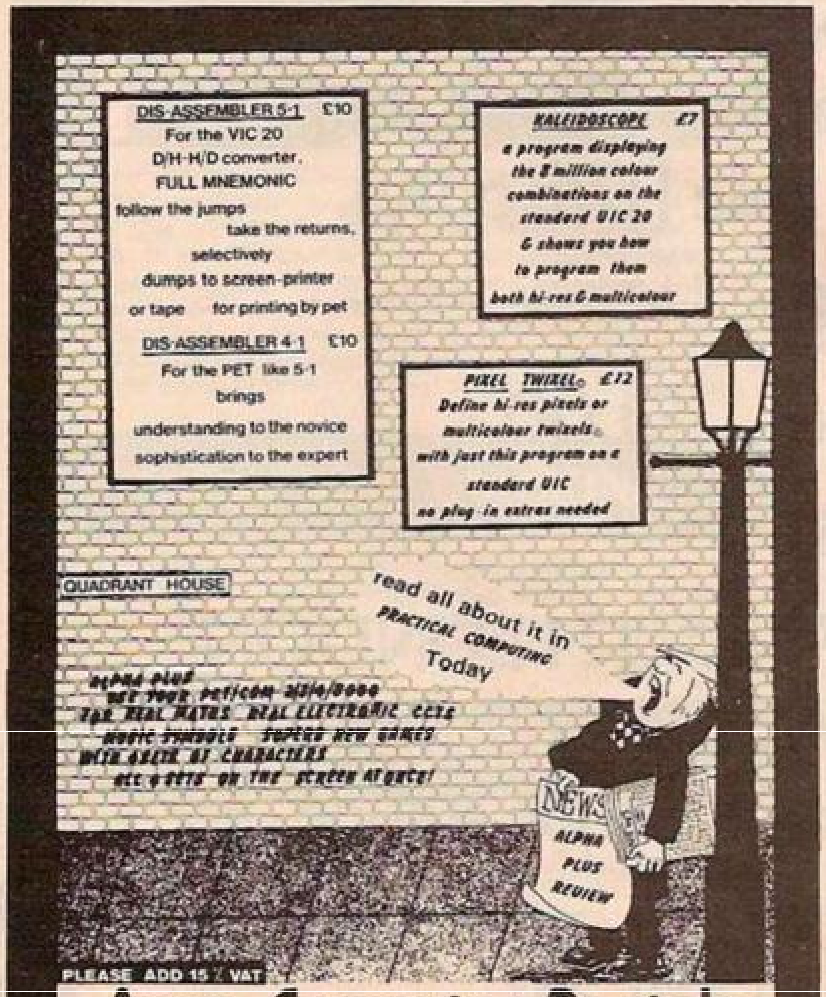
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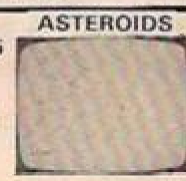
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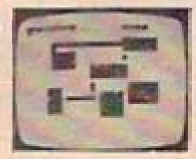
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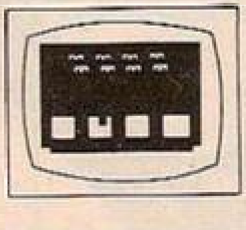
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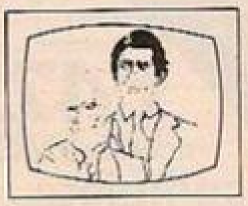
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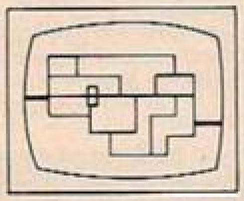
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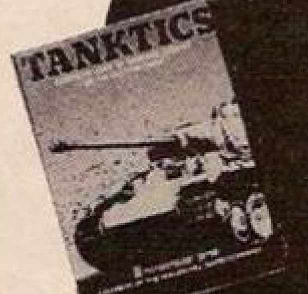
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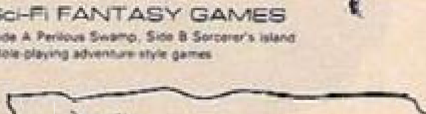
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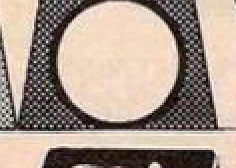


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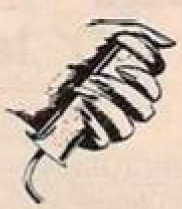
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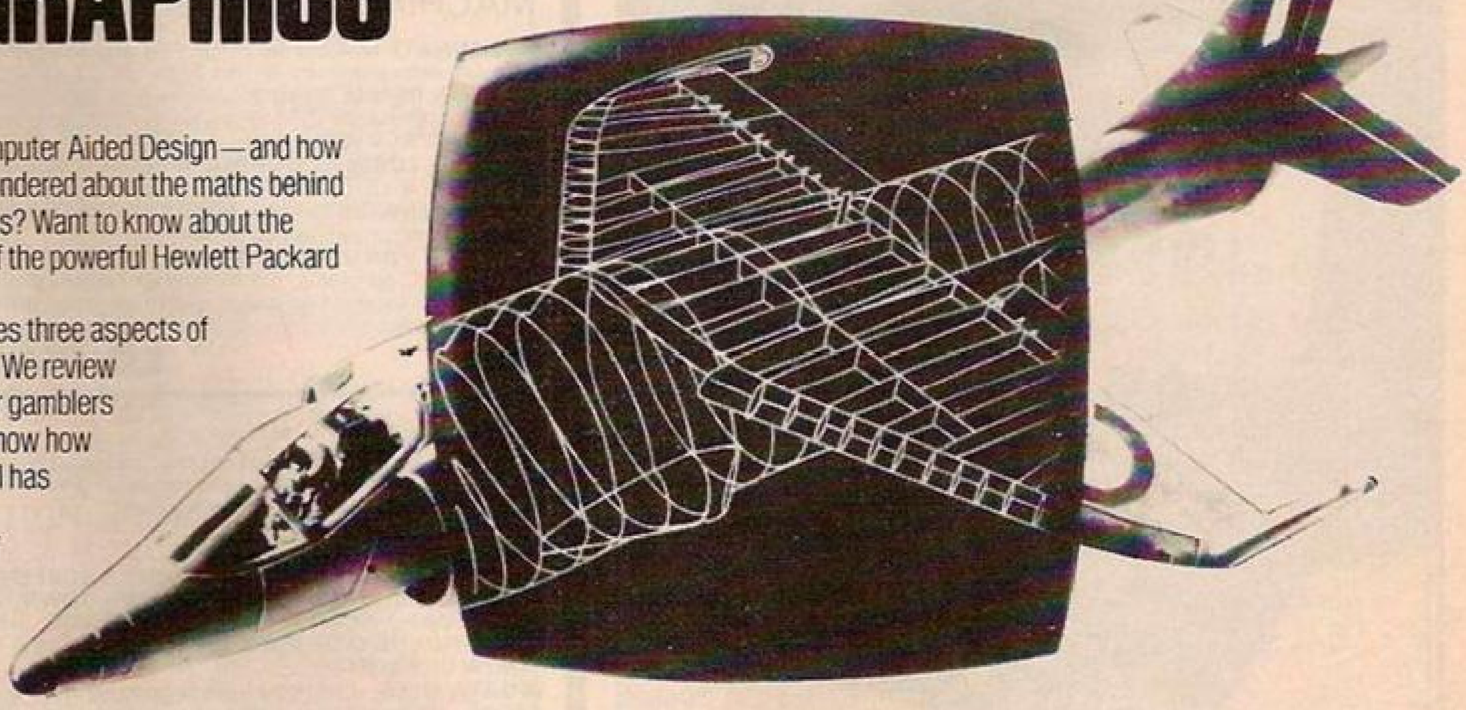
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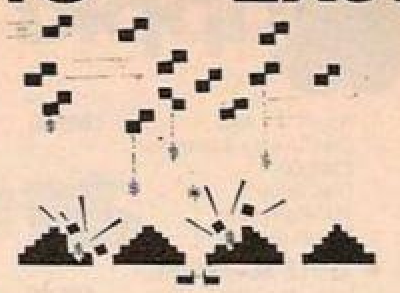


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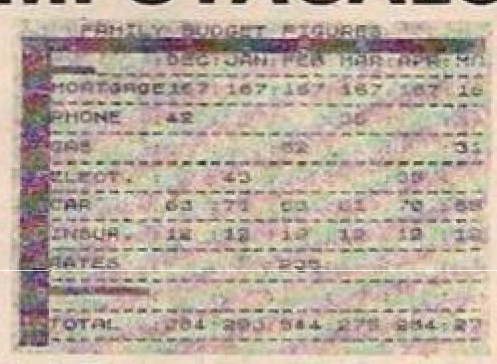
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Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

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The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.



Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – converts from decimal (base 10) to other bases of your choice in the range 2 to [illegible]

TEMP – Volumes, tem[illegible]ratures – and their combinations.

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	17	*8K BASIC ROM for ZX80	£19.95	
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